14 September 1961

rnborough Review

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FLIGHT

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The world's number one feeder liner, powered by Rolls-Royce Dart turbo-prop engines.

ick turnround—More flights—Low operating costs—Greater profit margin

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In Aircraft Wheels

These illustrations are full size and show some of the wide range of Timken bearings used in aircraft wheels. The bearing on the right is 16.5-inch bore.

Timken bearings are compact and light in relation to their high capacity for both radial and thrust loads.

Whatever the proportion between these loads, there is always a Timken bearing to suit the conditions.

British Timken, Duston, Northampton, Division of The Timken Roller Bearing Company. Timken bearings manufactured in England, Australia, Brazil, Canada, France and U.S.A.

TIMKEN®

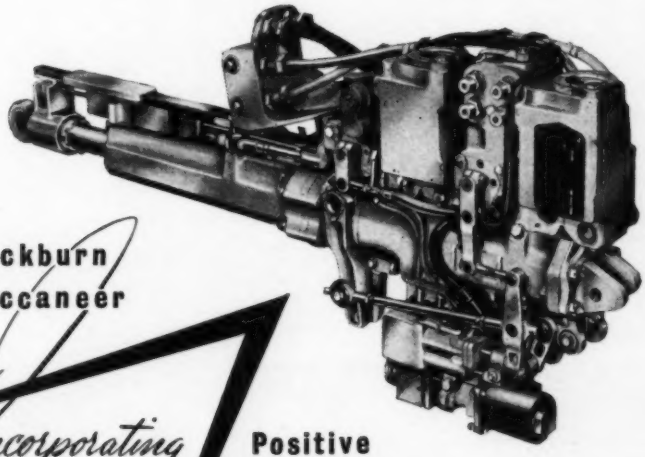
REGISTERED TRADE-MARK

tapered roller bearings

In another advertisement may be seen some of the Timken tapered roller bearings used for other aircraft applications.

RELIABILITY BREEDS CONFIDENCE

The pilot's control of his aircraft is at all times positive and precise, instilling in him that confidence in manoeuvre so vital to successful accomplishment.



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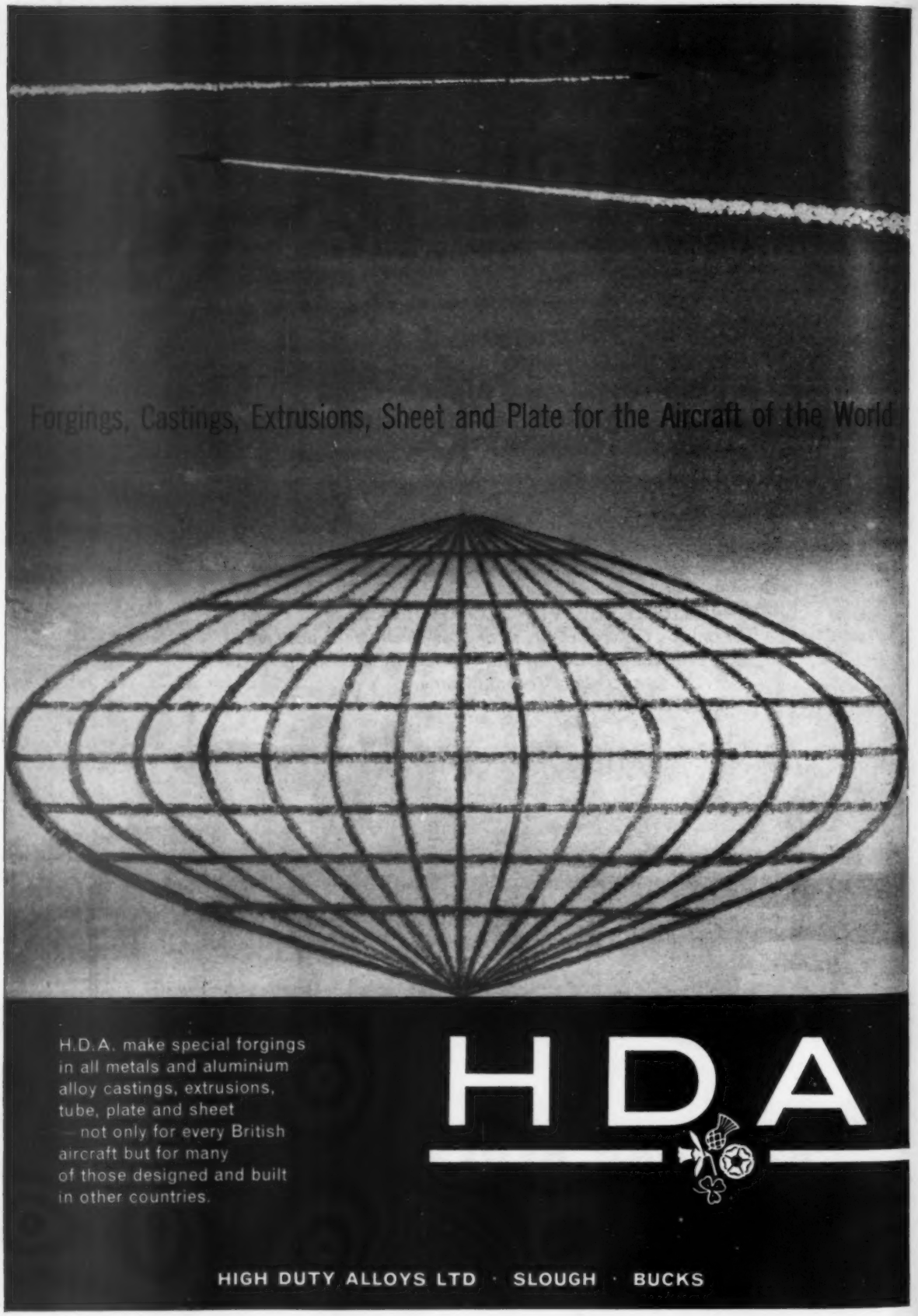
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H.D.A. make special forgings in all metals and aluminium alloy castings, extrusions, tube, plate and sheet — not only for every British aircraft but for many of those designed and built in other countries.
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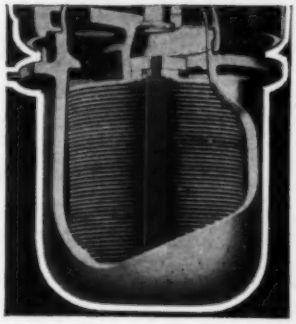
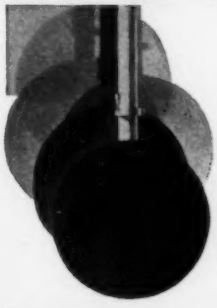
Specified for the latest military and naval aircraft, Parmatic Filters operate over a wide range of system pressures and environmental conditions.
The filter element is fabricated from 'Parmesh', an extremely fine stainless steel cloth ensuring filtration of 10 microns absolute rating.
It is suitable for use with all hydraulic fluids, including DTD.585, "Skydrol", and DP.47.





WHEELS & BRAKES

Palmer wheels and brakes, widely specified for today's light aircraft, helicopters and gliders—and for the unconventional Hovercraft and Brittain Norman Cushioncraft—are the outcome of many years of research and practical development work. No less for the aircraft of tomorrow—for prototype and production—these Palmer facilities are available to the designer.

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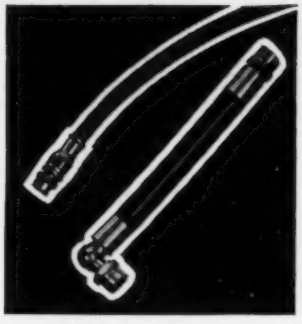

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SILVOFLEX 200 is specified by leading manufacturers in the aircraft industry and has logged millions of flying hours.
FLUOROFLEX pipes are completely inert to all aircraft fuels and lubricants, have indefinite shelf life and wide temperature and pressure ranges. They are fitted to many civil and military aircraft and are being specified for many prototypes.

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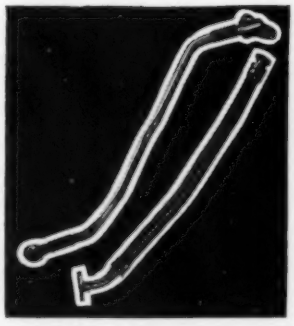
PALMAFLEX (convoluted stainless steel) flexible metallic pipes are already proven on jet airline service throughout the world.
CORROFLEX (corrugated stainless steel) pipes withstand sustained severe airborne vibration that would cause failure in other rigid pipes. Palmer facilities include an exclusive orbital welding technique in addition to the normal jointing methods.



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Palmer low-tension electrical harnesses are unique in design—ease of assembly and servicing being ensured by their sectional system of construction. Already fitted to the Rolls-Royce Dart and Conway engines, these harnesses can be custom-built to meet the most stringent service conditions . . . the ability to resist attack by all known aircraft fluids is particularly important.

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6. Luxury dimensions between armrests. Nominal 19" seat, variable to requirements.
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   Weight: Approx. 48 lb.
7. Double and triple versions available.

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SPECIALISTS IN AIRCRAFT SEATING

This luxury tourist class seat has applications for all aircraft types. Upholstery style adjustable for tourist or first class requirement.

Rear view shows retractable meal tray which is recessed into lower back squab. Two net magazine pockets fitted.

This robust seat is constructed from argon-arc welded Magnesium Alloy and Aluminium Alloy Sections, and is primarily designed to cover tourist class and semi-first class applications.

Upholstery features either foam rubber or plastic foam Lancedown interiors with ultra-modern woven cloth or all-leather coverings to requirements.

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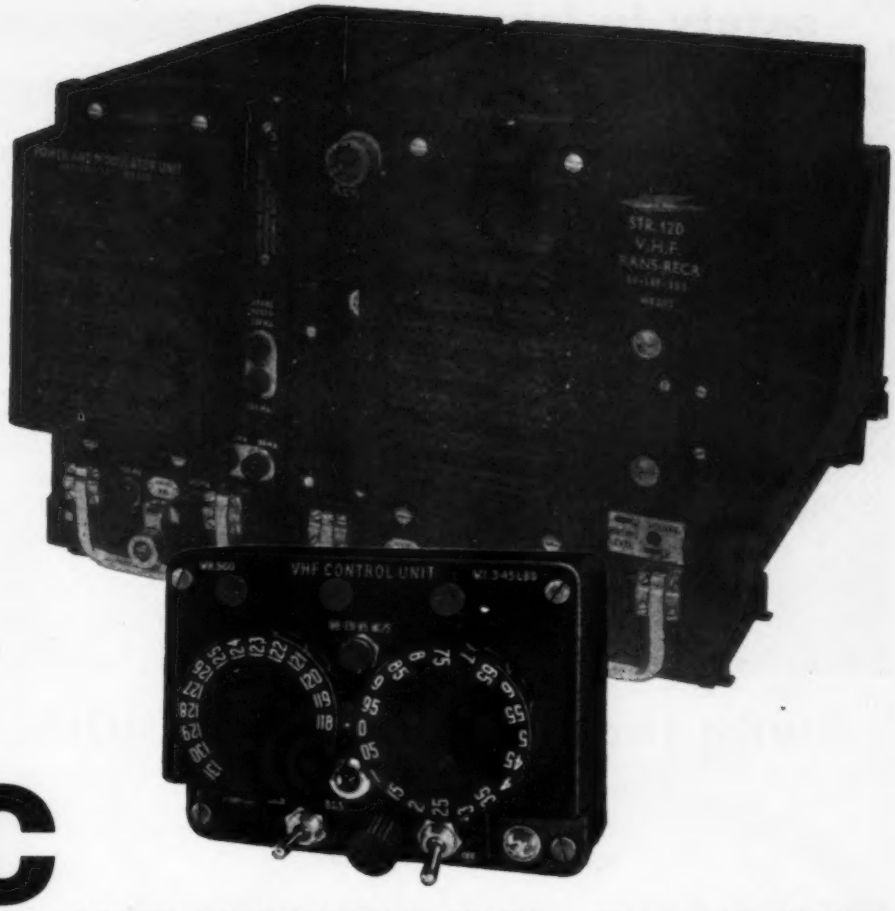

STC

CONVERSION KIT Type A.1207 for STR. 12-C and D

The STR. 12-C and D series of V.H.F. communication equipments can now be modified to provide 280 channels spaced 50 kc/s to conform to the new international requirements.

The A.1207 Conversion Kits provide for the adaptation of any existing 70 or 140 channel STR. 12-C or D equipment, spaced 200 or 100 kc/s apart respectively, to 280 channels spaced by 50 kc/s.

Two types of kits are available, one including a replacement I.F. Unit, the other providing a set of components with which to modify the existing I.F. Unit.

Both kits contain a 280 channel Control Unit fitted with 54 close tolerance crystals. This unit is interchangeable with the existing one.

The A.1207 Conversion Kit has been purchased by The British Overseas Airways Corporation for modifying their STR. 12-C and D equipments.

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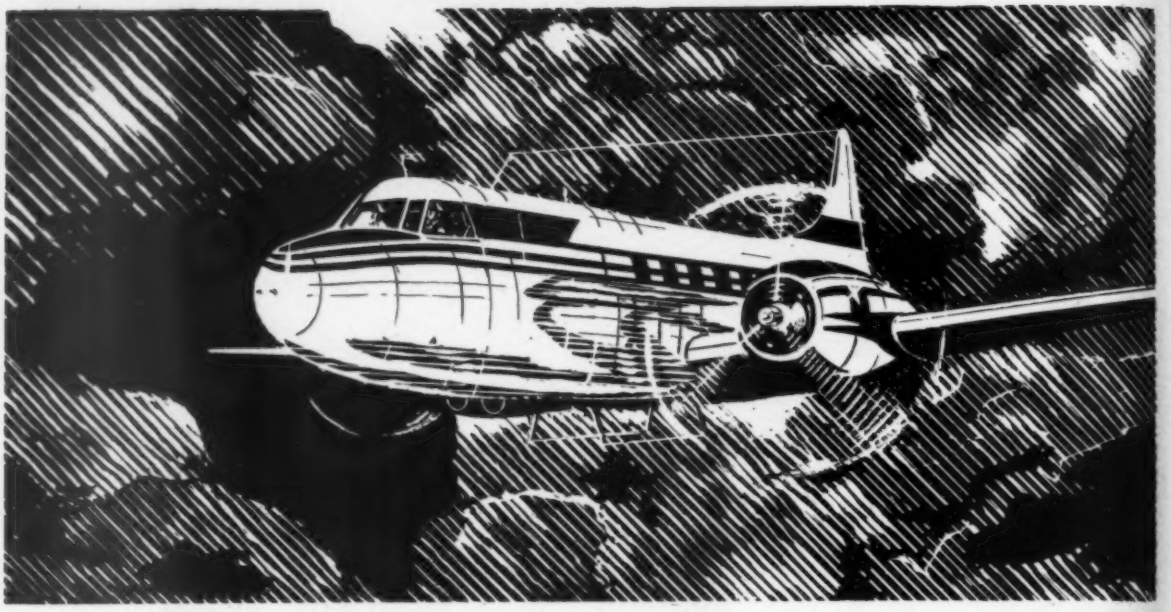
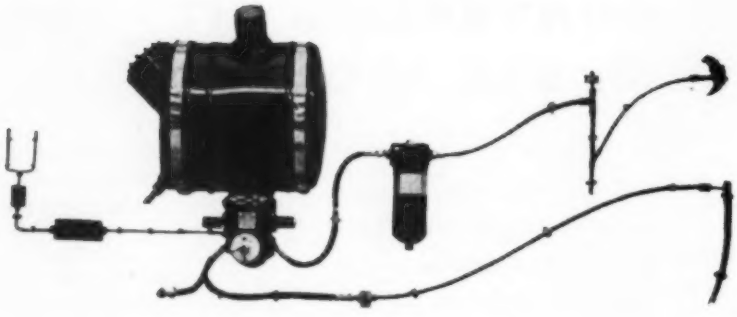


with the T.K.S. FLUID DE-ICING SYSTEM

The T.K.S. System is suitable for airliners, freighters, private planes and all civil and military types of aircraft.



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- Safety for the aircraft structure, if the System continues to operate in dry air; as no heating is involved

We will gladly prepare a preliminary schedule of weight, fluid consumption and cost for YOUR aircraft, without any obligation on your part

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PAL 16A

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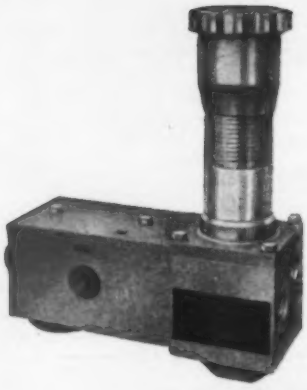

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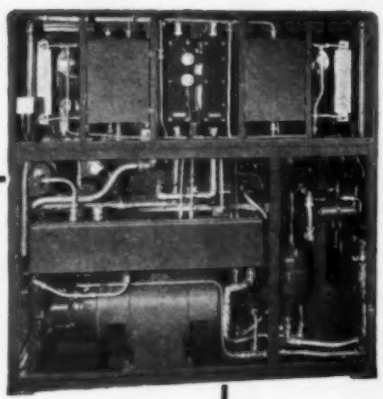

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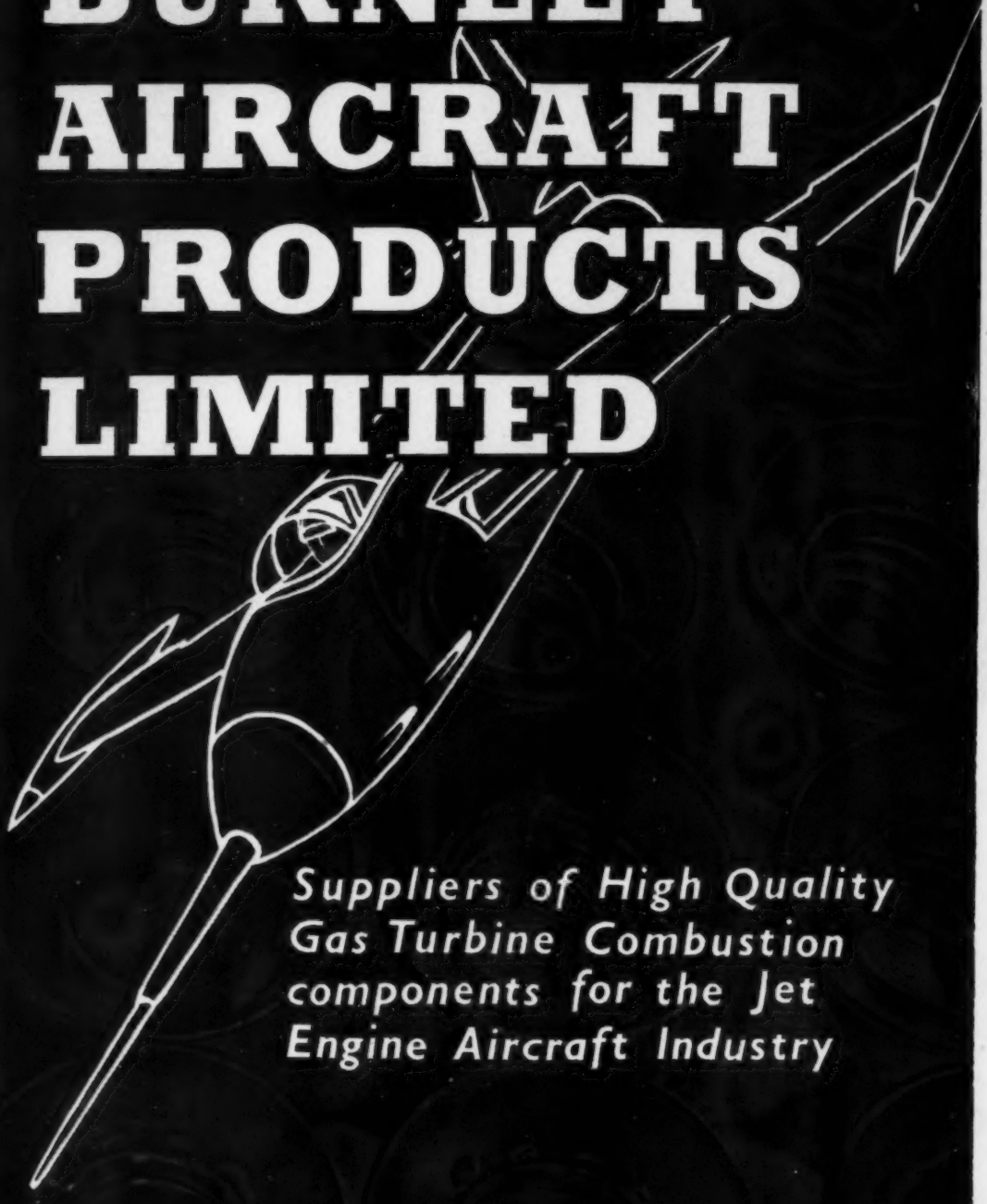

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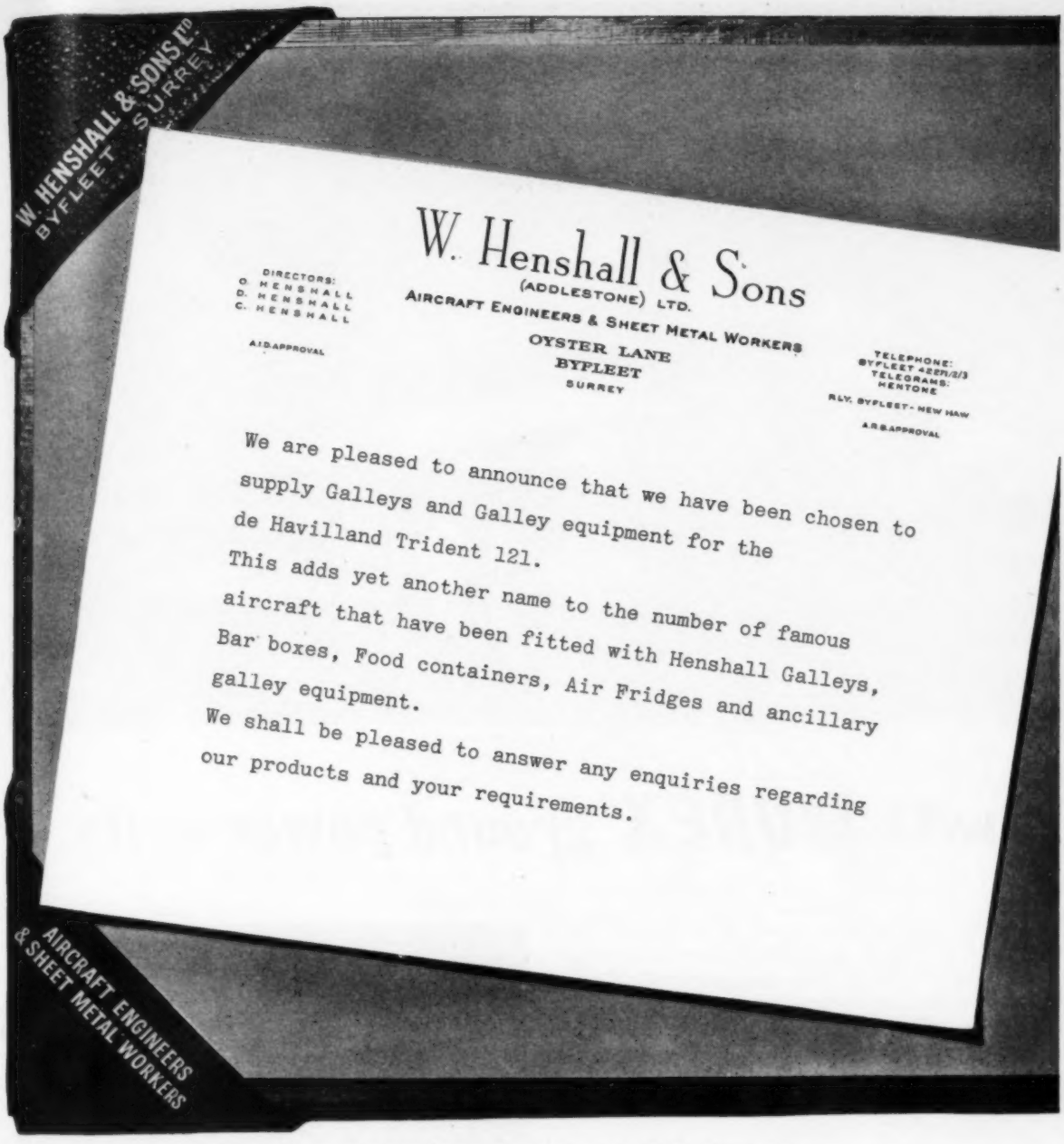
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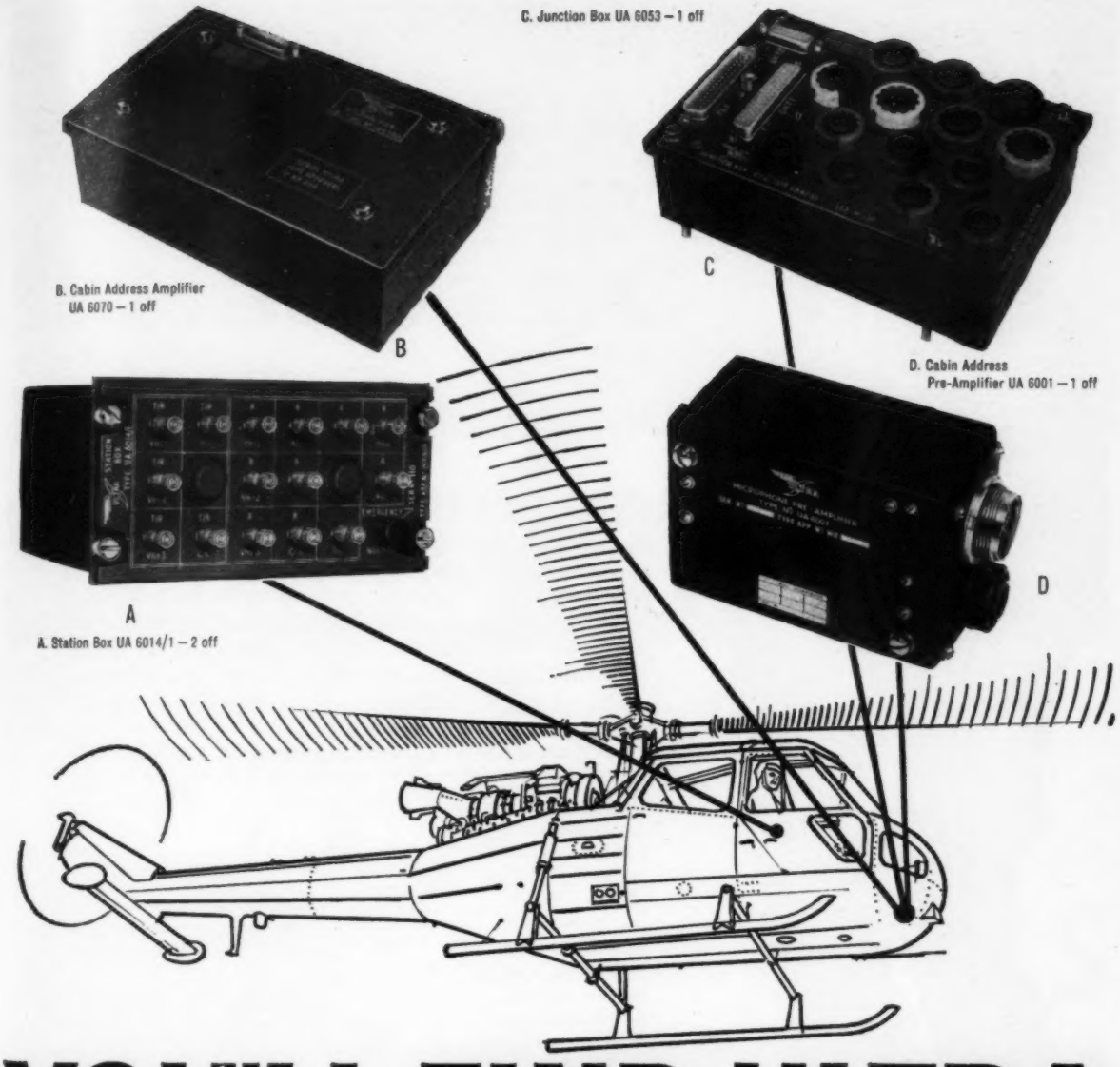
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* *Announcement by courtesy of the Saunders Roe Division of Westland Aircraft Limited*

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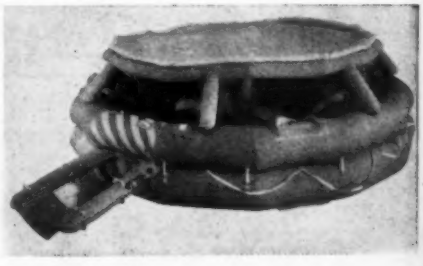
The crewman is wearing a Pressure Jerkin and an Anti-G-Suit.



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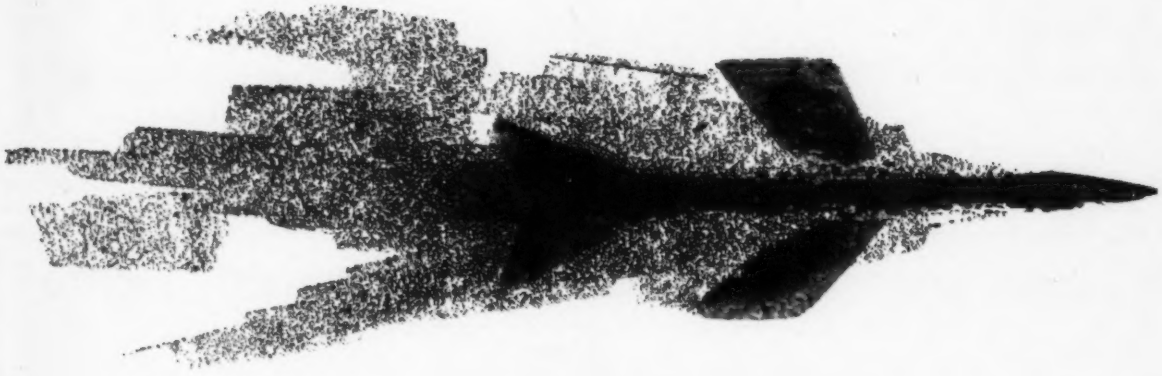

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High flow reducing valves

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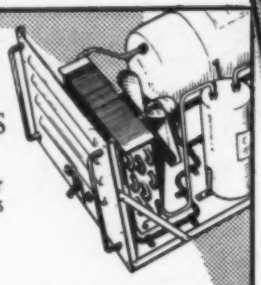

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Fifth engine tests Boeing 727 design feature

The Boeing 707 prototype, which proved out advanced design features of the Boeing 707 and 720 jetliners, is now at work as a flying test bed for the next generation of Boeing jets—the three-engine short-range 727.

The prototype is shown above equipped with a fifth engine, conducting exhaustive tests of the efficiency and performance of side-mounted engines, a feature of the 727. In addition, the 707 prototype is testing new high-lift wing flaps, aircraft systems and other design features that will make the 727 the most advanced jetliner of its class.

Already, ninety-two 727s have been ordered by Eastern Air Lines, Lufthansa German Airlines and United Air Lines for delivery beginning in 1963. The 727 will operate from 5,000-foot runways with full payload and will serve routes from 150 to 1700 miles. It offers airlines many unique advantages, including components and systems that have demonstrated outstanding performance and reliability in more than 300,000,000 miles of Boeing jetliner operations.

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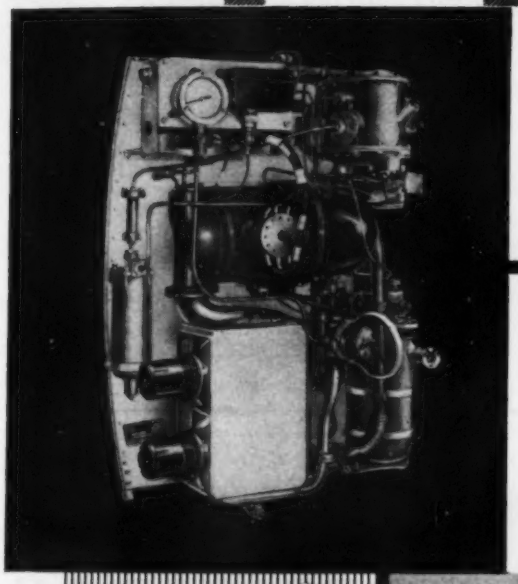

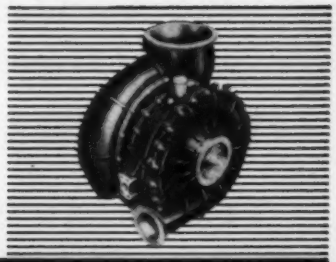

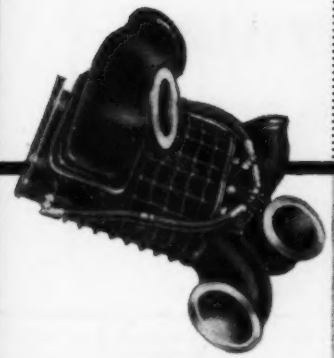

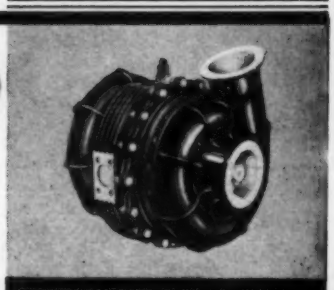

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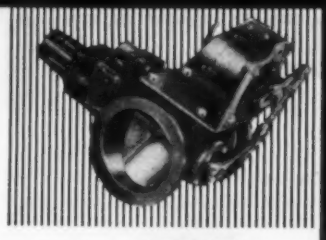

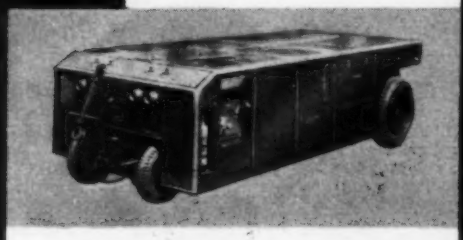

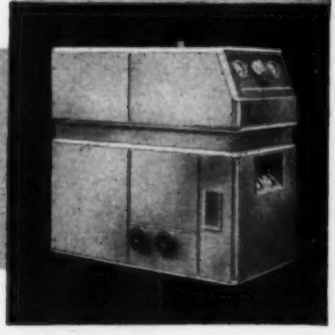

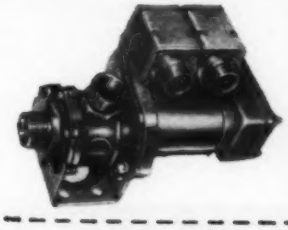

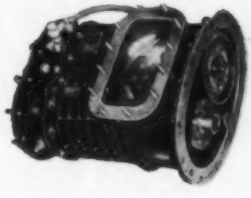

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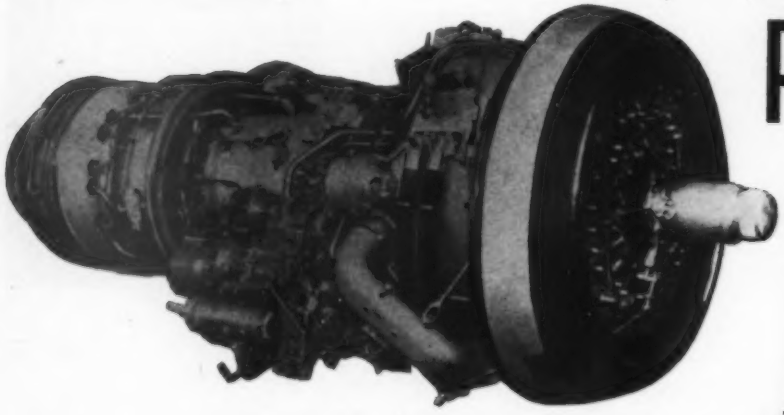

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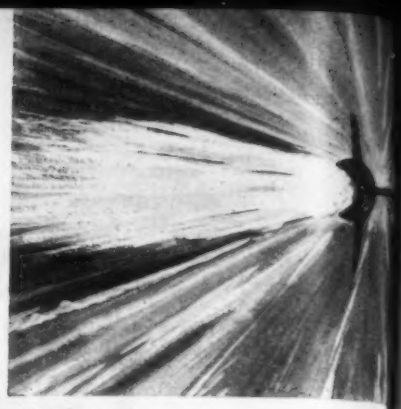

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Britain's Shape

IF it is admitted that Farnborough 1961 was not a vintage year for aircraft it must equally be allowed that it was not altogether a year of vintage aircraft—notwithstanding broadsheets glimpsed along the road proclaiming "Old Time Flying Display." (These were variously attributed to *agents provocateurs* in the pay of one of *Flight's* American contemporaries and—a more plausible ascription—to a recent function of the Tiger Club.)

Above all, this was the year of the Beagles and H.P.115; and upon the inward eye that is the bliss of solitude that now ensues, the shape of the Handley Page slim-delta flashes as something arresting and portentous. For while the Americans pour their treasure and their trust into the bottomless bucket labelled "Mach 3 at any price," and while the Russians declare that the supersonic airliner is "still a question for investigation," we in Britain are content to be flying a long-considered, and now tangible, Shape.

E-66 and All That

WE recently had something to say on this page about the game of Intelligence, a cat-and-mouse affair which has humorous aspects as well as grim. Anyone who has been engaged in this business, especially where aircraft are concerned, is only too keenly aware that one of the most essential requirements is that of being able to put a name to a machine. Thus, because the Western Allies have not discovered the true designations of the principal Soviet military aircraft, or because they do not wish to disclose that they have discovered them, they apply an awkwardly funny system of code-names. A new zest has been added to the game now that the Russians have (or appear to have) adopted an entirely new system of nomenclature, forsaking the contraction of a designer's name (e.g., Yak = Yakovlev) in conjunction with a type number, for mystifying combinations of letters and figures, e.g., E-66.

Among the possible explanations are (1) that the new designs are so much the work of consortia that it is considered invidious to ascribe a particular name; (2) that the Russians are deliberately cheating a little by "leaking" bogus, and hence confusing, designations. When the Soviet delegation to Farnborough was asked last week who designed the E-66 there was notable hesitation before the answer was given as "Mikoyan." And there was some obvious hedging when the Russians were asked to identify a photograph purporting to depict the E-66.

Now comes a new twist in the game with the issue of the latest bulletin of international records by the Fédération Aéronautique Internationale. An item in this document, the contents of which were officially provided by the Russians, reads: "*Records Internationaux. Classe C. Groupe 1. Altitude (URSS). Gueorgui Mossolov sur monoplan E-66 A, à aile triangulaire, entièrement métallique. 2 moteurs à réaction, un T D R Marque R 37 F et un moteur G R D, marque U 2 —Puissances 6000 et 3000 kg. Aérodrome de Podmoskovnoe, le 28 avril 1961. 34.714 mètres.*"

Thus are our Intelligence services gratuitously provided (apparently) not only with the true designations of more-or-less secret aircraft and powerplants (the G R D is presumably a rocket) but also with figures for thrust.

This may be all very fine. But we are wondering if there was not a twinkle in somebody's eye when he formally declared to the International Aeronautical Federation the designation "U 2".

FROM ALL QUARTERS

SBAC Presidential Speech

PRONOUNCEMENTS of far-reaching importance were made by the Hon H. G. Nelson, president of the SBAC, at the annual Flying Display Dinner in London on September 7. Mr Nelson said that the reorganization of the industry had gone "very well." In the civil field, the growth of the transport market was at the present time faltering somewhat. "Accurate forecasts of traffic growth," said Mr Nelson, "have predicted a doubling of loads over 7-8 years. I am sure we can have confidence that these forecasts will, in fact, prove to be accurate, and the present disturbing falls in load factors will be a passing phase. We have every confidence therefore that our latest series of civil aircraft will find much favour with airlines during the next decade. For the future beyond that we have made a study on a co-operative basis between the industry and Government establishments which has been very detailed and very successful. Arising from this a design study of a Mach 2 airliner has been put in hand. In the field of air freighting it is encouraging to note that three tons of cargo are now carried internationally for every ton ten years ago, a rate of increase comparable with passenger traffic. We are hopeful that the elusive expansion of air freighting will shortly become a reality and we have therefore available a number of suitable machines to cater for this need."

Of international co-operation Mr Nelson had this to say: "We think there is considerable scope for greater co-operation on an international basis. First, the SBAC has been exploring with AICMA (International Association of Aero-space Industries) special ways and means of our industries working closer together. Secondly, we feel that the cost of some projects in the future will be so high that international co-operation between major groups of our country with those of another will be essential if unnecessary duplication and wasteful competition is to be avoided and if sufficient resources and a market of sufficient size is to be made available. We are steadily working to see if a satisfactory basis for such co-operation can be established. If such schemes are to be successful they must have within them the seeds of satisfaction for all partners. This will be difficult but not impossible."

Turning to the Common Market, Mr Nelson said: "No reference to the international scene at the present time would be complete without some comment on the recent application of this country to join the Common Market. Increasing size and performance has always been a feature of aviation development. Advantage accrues from increased size and performance of aircraft and engines, and also from increased size of markets and of technical and production teams and from increased size of Government purses. These are the factors which govern the economics of our industry, much more than comparative labour rates and tariff differentials. We are, of course, vitally concerned to ensure a satisfactory level of prosperity both in this country, among our friends in the Commonwealth and in the world generally. We, as an industry, have as much to gain as any from a rising level of living standards throughout the world. With these factors in mind and in the confidence that our industry has much to offer in both experience and expertise, we feel that membership of the Common Market will be beneficial provided that such membership can cater for the vital needs of the Commonwealth countries."

British Business

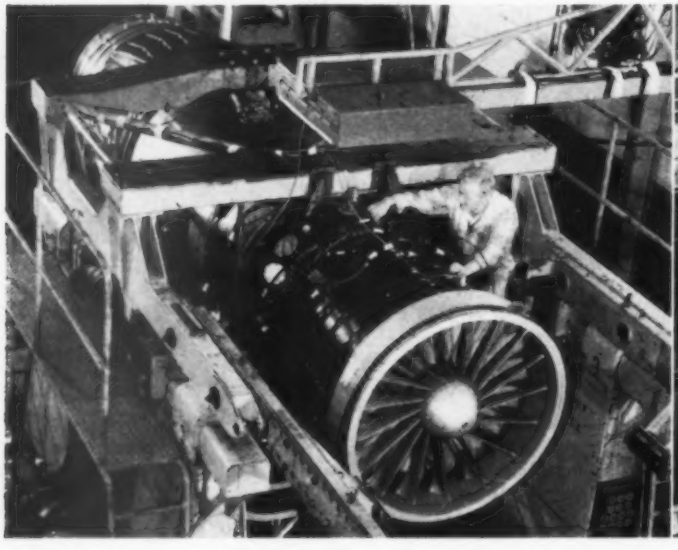
LAST week several new orders for British aircraft and engines were announced—in most cases timed to coincide with the SBAC Show, reported on pages 416-441. Largest order was for five Vickers VC10s for RAF Transport Command; this is referred to in greater detail on page 447. In competition with "almost every jet-airliner manufacturer in the world" de Havilland sold a very special Comet 4C for use as a mobile Royal palace by King Ibn Saud of Saudi Arabia; specially furnished, it will cost about £1.25m. On page 421 news is given of further sales for the Herald and Dove, together with heartening news of the immediate success of the Beagle pack. Finally, Bristol Siddeley Engines have received a contract worth £1m for Viper 520 turbojets for the D.H.125.

TWA Orders Caravelles

WITH TWA's announcement on September 7 of an order for 20 Caravelle 10A short/medium haul jets, plus an option on 15 more, the second of the US Big Four has now decided in favour of French jets. The Mk 10A version, also known as the New Caravelle, will be powered by General Electric CJ-805-23C aft-fan engines (Caravelles of United are Avon-powered) and the order is worth over $100m (over £35.7m) to Sud Aviation. It will certainly be worth a great deal in prestige to France's aircraft industry, especially since TWA, like United, had always bought American equipment before. Deliveries are scheduled to begin from the Toulouse factory in January 1963, and will be completed by July of that year. TWA's Caravelles will seat 68 first-class or 85 tourist passengers, and the airline will presumably use them on routes now served by Martin 4-0-4s and the older Constellations.

According to the *Financial Times*, TWA is seriously considering leasing—or perhaps even buying—a small number, perhaps two or three, of Avon-powered Caravelles for crew training and familiarization. This latest order is a blow not so much to Boeing and the 727—for TWA had recently ordered 20 707-131Bs and 6 707-331Bs, and has four 720Bs leased from Boeing—but to the Trident and to a lesser extent the TWA-sponsored Convair 880. Now that TWA is no longer under the financial control of Howard Hughes, its re-equipment plans can be made on a much firmer basis, and without the past delays which have led to its competitive position being undermined. Its Caravelle order brings the order book for this aircraft up to 139, and it may not be without significance that the

CONWAY AND PEGASUS are two of the most advanced aircraft powerplants yet produced. These new illustrations show, left, a Conway RCo.42/1, of 21,370lb minimum thrust for the VC10, on reverser test at the Rolls-Royce works at Derby, and a Pegasus lift/thrust engine for the Hawker P.1127 VTOL strike aircraft on one of the special beds built for it at Bristol Siddeley's works at Patchway



THE PARTS ALL FIT: manufactured in France, Germany, Belgium and Holland, powered by British Rolls-Royce Tynes driving de Havilland propellers, and filled with American electronics, the first Breguet 1150 Atlantic has been rolled out from Toulouse. It should fly in November, followed by the second prototype early next year. This long-range ocean patroller will enter service with NATO nations in 1963

"Flight" copyright photograph

SBAC CENTURY: On Thursday of last week at Farnborough, the Society of British Aircraft Constructors notched up its 100th flying display. Seen here on that occasion are the two men mainly responsible for organizing these displays, Mr E. C. Bowyer (right), SBAC director, and Mr H. W. Goodinge, assistant director

DRAGON'S NEW TEETH: Even when the Royal Swedish Air Force have their Bloodhound 2 missiles in service they will continue to use the Saab J35F version of the Draken, shortly to enter service. Powered by a Svenska Flygmotor Avon RB.146 with afterburner, it has a new radar and sighting system and carries two Rb324 Falcon missiles

order was announced shortly after the French Government's decision to underwrite production up to 200 aircraft to keep up the momentum of deliveries.

Fokker-Breguet Agreement

IN VIEW of what they describe as a "steadily increasing order book" for the F.27 Friendship family, coupled with their vast effort on the Atlantic (picture above) and F-104 programme, Fokker have for a considerable period been investigating means whereby manufacture of the Friendship could be shared with another company outside the Netherlands. (It is reported that discussions have been held with British manufacturers.) Fokker now announce the signing of a contract with Breguet, under the terms of which the French company will manufacture major portions of the "F.27 and variants."

Exactly which portions are involved is not defined, but it seems to include the entire fuselage apart from the front section and nose, together with the wing centre-section (less flaps) and most of the tail unit. The work, which is to begin in four to five months' time, will be based at Breguet's Biarritz factory, whence 60 to 70 technicians are now attending a Fokker F.27 familiarization course. Completed airframe sections will be taken by road to Schiphol.

German Merger

THREE aircraft companies in Northern Germany are to form a group which will carry out combined research and development and co-operate in future projects. The companies are Focke-Wulf and Weser Flugzeugbau, both of Bremen, and Hamburger Flugzeugbau of Hamburg.

Robert Ellsworth Gross

WE record with regret that Mr Robert Ellsworth Gross, chairman of the board and founder of Lockheed Aircraft Corporation, died recently in Santa Monica, Cal, at the age of 64. Mr Gross, who was the company's principal executive for 29 years, headed a small group which in 1932 bought for $42,000 the then bankrupt Lockheed Aircraft Corporation. During his association with the company, it grew to rank twenty-eighth among industrial concerns in the United States, with 66,500 employees.

IN BRIEF

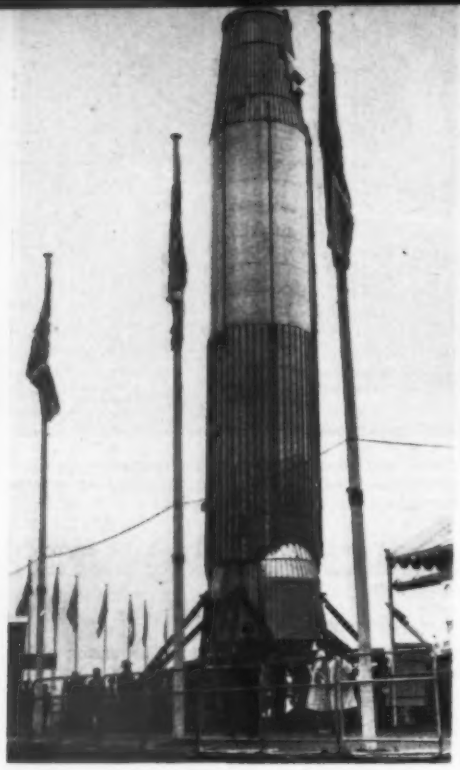
Four squadrons of USAF F-100s flew to Europe to participate in the three-day NATO exercise Checkmate, which began last Tuesday.

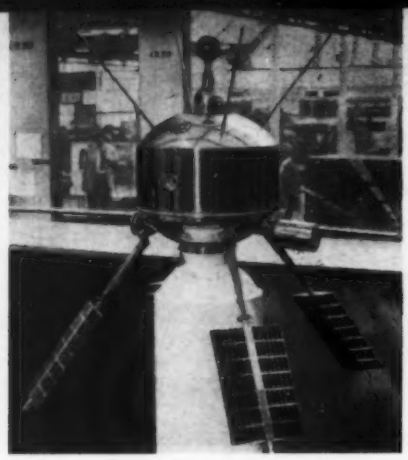
General Laurence S. Kuter, USAF, C-in-C NORAD since August 1959, was last week awarded the McCurdy Medal in Toronto for "outstanding contributions to world aviation."

According to a London newspaper United Arab Airlines have decided to buy four Boeing 707s for delivery starting in mid-1963. A spokesman for British Aircraft Corporation has said that his company has not received any information indicating that UAA have now decided not to purchase VC10s.

British United Airways will give basic helicopter flying training to 24 Royal Navy and Royal Marine pilots for the Commando carrier HMS *Albion*. BUA will run six courses over a period of 43 weeks at Redhill, using Whirlwinds and Hillers. This is the first time that an airline has provided helicopter instruction for Navy personnel.

The Dowty group have announced that Lt Gen Sir John Evetts is retiring on September 30. He will relinquish his directorship of Dowty Fuel Systems and is to devote his time and energy, on a voluntary basis, to furthering the aims of the Three Counties Industrial Education Association, of which he is president and chairman of council.





"Flight" photographs

Rockets and satellites at Farnborough: left, the Blue Streak which dominated the missile park outside the exhibition hall; centre, Westway-built model of the first joint US/UK ionospheric satellite, seen on the British Aircraft Corporation stand; and right, a meteorological sounding rocket of the type displayed on the Bristol Aerojet stand

Missiles and Spaceflight

POLARIS A3 DIFFICULTIES

During the past year it has been amply evident that Lockheed Aircraft Corporation have been writing-off their substantial losses on the Electra airliner with equanimity, in view of the vast scope and production potential of the Polaris fleet ballistic-missile programme. Polaris A1 is now widely deployed in operational submarines, and the extended-range (1,500 n.m.) A2 version is well advanced in its development firing programme from Cape Canaveral. But much depends on the ability of the company's Missiles and Space Division to wring out still further extensions in performance, and our US contemporary *Aviation Week* reports that this work has run into difficulties which may be of a serious nature.

The most severe troubles have arisen in the new first stage, which represents a state-of-the-art advance in solid-propellant rocket technology. According to the American journal, the design chamber temperature and pressure in the Aerojet-General first stage are no less than 6,300/6,600°F and 800/900lb/sq in. These levels must combine to create case and nozzle conditions substantially in excess of anything previously attempted, and it is suggested that a lower temperature may have to be accepted. A reduction to 5,800/5,900°F would cut the range of the A3 missile from 2,500 to 2,300 n.m., and even this would probably not be reliably attained without great development effort upon the nozzles and jetevators.

Lockheed are said to be promoting an entirely new A4 version, with single (one imagines, probably gimballed) chambers in both the first and second stages. These purely hypothetical studies are said to be aimed principally at the US Air Force, for a land-based missile would not be subject to the same restrictions on diameter and length as are imposed by the Navy's submarine launch tubes. In retrospect, it appears to a British observer that the dramatic success of the original Polaris A1 may have led both the Navy and Air Force to adhere with undue tenaciousness to the concept of multiple nozzles. Polaris was originally designed with four nozzles in both first and second stages in order to reduce missile length (and possibly also overall launch weight).

For shipboard use, Polaris A2 will certainly have to retain its four short nozzles, but the A3 or projected A4 may well appear with deflecting nozzles in place of the relatively heavy and snag-prone jetevators. Aerojet-General have already conducted extensive research into glass-fibre nozzles (constructed along lines similar to those currently used in the second-stage motor case), and into the use of gas bleed jets from the motor itself to provide deflection of the main efflux. Much depends upon the results achieved in the extensive static and flight testing of these very advanced solid-propellant motors, for they may well have a profound influence on the giant boosters used for space launchings a decade hence.

APOLLO ENVIRONMENTAL CHAMBER

An expenditure of at least $25m is expected to be required to construct and equip for the US National Aeronautics and Space Administration an environmental test chamber much larger than any other so far built (outside the Soviet Union, at least). To be staffed by the Space Task Group at NASA's Langley Laboratory, the new chamber will be a sphere approximately 100ft in diameter, which will be amply large for environmental tests on existing and projected spacecraft—in particular, the three-man Apollo.

The sphere must, in fact, be much larger than the craft which will be mounted in it, for among the tests which are envisaged are the firing of attitude- and trajectory-control jets in order to investigate their correct function under vacuum conditions. Although in flight firings the rarified and ionized environment will have an "airspeed" of some 20,000 to 25,000 m.p.h., the effect of this on the formation of rocket flames is a minor one, and the new chamber should also be able to investigate the reaction between the control jets and the vehicle with satisfactory accuracy. Other tests will be concerned with the performance of all airborne systems, including biological investigations and human engineering. This environmental-test chamber, and its associated mission simulator and astronaut-training school, will be the nucleus of the projected NASA Laboratory for manned spaceflight.

ALLISON WIN MINUTEMAN CONTRACT

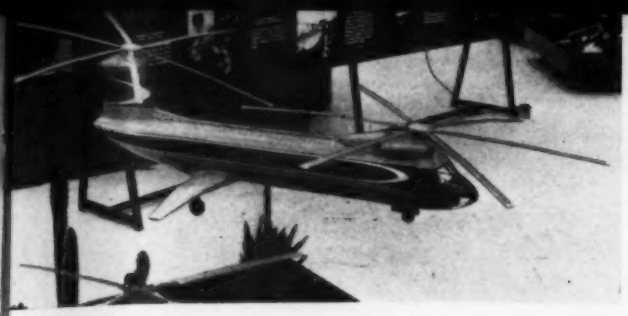
It was announced on September 1 by Mr Harold H. Dice, vice-president of General Motors and general manager of the Allison Division, that the latter company have been awarded a $10,935,000 subcontract from Thiokol Chemical Corporation for the production of rocket cases for the first stage of Minuteman, the second-generation US Air Force ICBM.

This major contract is described as "the climax of more than two years of intensive development of thin-wall, flight-weight steel cylinders," which are fabricated by precision welding and house the polybutadiene-based solid propellant charge. Allison have already delivered a substantial number of prototype first-stage cases for static and silo tests, and these were used in the fully successful first and second flights of the missile down the Atlantic Missile Range on February 1 and July 27. The company claim that their cases have so far established a 100-per cent reliability record. Deliveries of production cases will start this month, and under the existing contract will continue at about the same rate as for prototype cases until the late autumn of next year.

CENTAUR AGAIN DELAYED

General Dynamics/Astronautics, prime contractor for the Atlas-Centaur vehicle, have had to postpone the launch of the first flight specimen for approximately three months. During the past year Pratt & Whitney Aircraft, at West Palm Beach, Florida, have suffered a number of minor difficulties in the development of the LR115 liquid-hydrogen/liquid-oxygen engine (two of which power the Centaur second stage) and these have now forced a postponement of the first flight until February next. The vehicle concerned has been on its pad at Cape Canaveral since the early summer. The programme is now running almost nine months behind the schedule originally programmed.

(Further "Missiles and Spaceflight" news: pages 452-453)



Although it was not displayed by Westland at the SBAC display, on the Hawker Siddeley Aviation stand was this model of the Westland (Bristol) 194, a 30/50-seat transport helicopter project powered by four de Havilland Gnomes

AIR COMMERCE

ITAVIA ORDERS HERALDS

AN order worth over £500,000 for two Handley Page Herald 200s has been placed by the Italian domestic airline Itavia—Societa di Navigazione Aerea SpA. An option has been taken on a third. Purchase of Heralds presumably foreshadows a big expansion by Itavia, for this carrier's current scheduled services consist of one flight on weekdays only between Rome and Siena, one daily afternoon flight between Rome and Pescara, a daily afternoon flight between Rome and Genoa and an additional morning weekdays-only service on this route. All these services are operated by a fleet of two Herons and one Dove. Itavia, which started operations in July 1959, is the only Italian independent operating fixed-wing aircraft. Its original intention was to increase its Heron fleet to seven, but this plan appears to have been postponed in favour of Herald operations.

Itavia's early growth has been nourished by the fact that its routes, although they have a high traffic potential, are not served by Alitalia. This has enabled the company to keep overheads and indirect costs as low as possible, enabling very low fares to be offered at a per-mile rate almost exactly the same as on Alitalia's subsidized internal services. Undoubtedly a powerful factor in Itavia's choice of Heralds is that all the airfields at Siena, Pescara and Genoa have only about 1,100 metres of grass or concrete, although Genoa's new runway has since been lengthened to take Alitalia's Convair 440s.

Footnote: As this page goes to press it is announced that Maritime Central have taken up their option on a third Herald 200. Total Herald sales are now 16, as follows: MoA, three Series 100 (for BEA); Jersey Airlines, six Series 200; Maritime Central and Nordair, four Series 200; North-South, one Series 100; Itavia, two Series 200.

TWO TRAGEDIES

A TWA Constellation crashed on September 1 shortly after take-off from Chicago Midway, killing all on board, 73 passengers and five crew. The aircraft, on a flight from Boston to San Francisco apparently caught fire and exploded before narrowly missing houses and crashing into a field about ten miles from Chicago.

A worse disaster was to follow on September 10; as the page went to press it was learned that a DC-6B of President Airlines, a new US "non-sked" (see last week's issue, page 405), crashed into the Shannon estuary one minute after taking off from Shannon airport at 3.53 a.m. en route from Düsseldorf to Chicago. All on board, the crew of six and 77 passengers (mostly German farmers), lost their lives. This brings the total number of airline accidents in 1961 involving fatalities to 27, and the total killed to 834.

AIR CEYLON'S PROBLEMS

ALL Air Ceylon's international services, at present operated by Electras, are to be suspended with effect from November 1. This decision follows a KLM announcement to replace the Electras used on their Far East services with DC-8s. Mr W. A. E. Molamure, general manager of Air Ceylon, says that turboprop equipment is no longer competitive, and KLM has found it necessary to replace Electras with DC-8s. As Ceylon has no airport which can accommodate the DC-8, KLM will suspend all international services through Colombo, becoming the second operator to take this step (TWA being the first).

A contributory factor to Air Ceylon's international demise is finance. The Government is to explore the possibility of entering into an alternative agreement with another international airline, possibly Air-India, to continue Air Ceylon's international services provided there are reasonable prospects of a profit. KLM recently stated that Air Ceylon should bear some of the losses incurred, to which the Ceylonese replied that they were not prepared to subsidize the service. Whether the domestic and regional services that Air Ceylon at present operate are profitable and can continue without subsidy seems extremely unlikely. The management of Air Ceylon has said that it will recommend the suspension of all services if these services are uneconomic.

As a result of the suspension, about 200 employees become redundant. If an alternative agreement with another operator is signed, it is unlikely that the redundant staff will be reinstated, as Air Ceylon is at present overstaffed. As already reported, a Cabinet sub-committee comprising Mr P. B. G. Kalugalla, Minister of Transport, Mr M. Senanayake, Minister of Industries, and Mr F. D. Bandaranaike, Minister of Finance, is to enquire into the future of Air Ceylon, and is to report to the Government shortly on its recommendations.

Runway extensions at Katunayake, financed by the United States Operations Mission, are due to start in October. BOAC will be the only international carrier serving Colombo, and will not be able to replace Comets with bigger jets until runway extensions are complete, which will take at least two years.

IRELAND'S PIG-IN-THE-MIDDLE

FOLLOWING representations by Pan American and TWA, the United States Government has requested the Irish Government to make an early revision of the bilateral air agreement signed between the two countries. Pan American and TWA are anxious to obtain permission to route their North Atlantic jet services to and from New York and Dublin, instead of Shannon. At present, TWA operate a twice-weekly return service between New York and Shannon and this is, in fact, the only scheduled transatlantic service terminating at Shannon. Significantly, TWA recently applied to the CAB for permission to suspend services to Shannon during the coming winter, from October 31 to April 1. Pan American transit Shannon on eight of their flights weekly between the United States, the United Kingdom and Germany.

At present, there is nothing to prevent a foreign carrier from holding the necessary licences to operate to Dublin, provided the aircraft land at Shannon on the eastbound and westbound transatlantic legs. The Irish point of view is that, first of all, the Irish Government should ensure that Shannon, in which Ireland has invested about £12m since 1935, should not be over-flown by airlines making transit stops in Ireland, and, secondly, should not grant facilities to foreign carriers that are not enjoyed by the national airline, Aer Lingus. At the root of Ireland's problem is the fact that Shannon—historically a transatlantic refilling station and alternate rather than a place that passengers want to go—is being rendered redundant by the improved range capabilities of modern aircraft.

HALF-FARES FOR YOUTH

ALTHOUGH US domestic carriers have been responsible for many of the most important developments in air transport, such as coach-class air travel, fare reductions on US domestic routes have mostly been "across the board," and promotional fare structures to cater for highly seasonal traffic demands, or to stimulate flagging traffic, are not so well developed in the States as in Europe. When Mr Anthony Milward of BEA visited the USA earlier this year he found that BEA's promotional fares aroused the interest of US domestic airlines. These carriers, faced with a net loss of $13,586,000 on domestic operations in the first six months of this year—the greatest for any comparable period since 1947—are now casting about for new promotional fares to boost traffic. Among these are half-fare rates for passengers between 12 and 21 years old; the CAB has given permission to 13 US carriers to offer these rates for a trial six-month period and they will be required to submit evaluation statements plus statistical data at the end of each three-month period on how the new rates are working out.

American Airlines, first carrier to propose these fares, has been offering them since August 30, and the other airlines—Braniff, Continental, Delta, National, Northeast, Northwest, TWA, United, Western, Central. Trans-Texas and Chicago Helicopter Airways—since yesterday. These half fares will apply to both single and roundtrip tickets on any flight, whether first-class or coach, jet or piston equipment. The six-month trial period will expire on February 28 next, except for National, who will cease offering these fares on December 10. Eastern, Mohawk and Pacific Air Lines have filed complaints requesting investigation and suspension of the scheme. American reports "widespread public interest" in the new fares, with many enquiries coming from young servicemen. The only condition attached to these fares is that reservations be made no earlier than three hours before flight time.

("Air Commerce" news and features are continued on page 456)

Illustrated mainly by *Flight* photographs

Farnborough Week

FARNBOROUGH 1961, the twenty-second SBAC Flying Display and Exhibition, will be remembered as having been successful at several levels. As to attendance, there were nearly 9,000 guests from overseas; on the public days, 24,000 people came last Friday, 85,000 on the Saturday and 100,000 on the Sunday. From a commercial standpoint the Society's president, Mr H. G. Nelson, expressed himself satisfied: many of the visiting VIPs, he said at a summing up Press conference, were of "decision making level"; further, equipment stands in the exhibition had done a fair amount of business.

Taking a look ahead at future displays, the president said that they would continue in much the same form, though the Society was seeking information from its members regarding a different approach to the show. The Flying Display would be generally on the same lines, with the Services playing a prominent part and "a sprinkling of new types of aircraft." 1962 would be "a vintage year" for new machines, including the D.H. Trident and 125, Hawker P.1127, Vickers VC10 and Bristol Type 188.

In the following report, the three public days are dealt with first, then—on pages 417-441—the trade days and the static exhibition.

Friday As the Army Air Corps was making its SBAC début this year, an opportunity of flying in their Skeeter formation seemed too good to miss; so *Flight*'s day began at the Army Air Corps Centre, at Middle Wallop. From there, soon after our Gemini arrived, Maj Stuart Whitehead, the display leader, took off with the writer for Aldershot in Skeeter XM565. After bowling over the Hampshire countryside at a comfortable 80kt, within half an hour we touched down on the grass area known as Queen's Parade.

During the morning, nine more Skeeters arrived from Wallop—giving a reserve of two aircraft in case of unserviceability. An R/T control had been set up on the parade ground, and there was a refueller. After the pilots had had a chance of seeing the show curtain-raisers, the gay Turbulents and the RAE-rebuilt SE.5a with its realistic machine-gun burst, they had a final informal briefing from Maj Whitehead.

At 1519 we started up. Over the R/T the wind was given as 040 "less than 5kt" (ideal conditions for this type of demonstration). "Blue" leader had radio unserviceability, so had changed to one of the spare aircraft, which had been started in readiness. At 1525 we were airborne, swinging away to starboard over the blue roofs of some of the Aldershot barrack buildings. The other three "red" aircraft slipped into diamond formation ahead of us, so that we were then the last machine in the section. Maj Whitehead called: "Red leader, formation: Z minus two, Z minus two, now." He then gave Z minus 1½ and Z minus 1 and called Farnborough Tower: "Are we clear to come in?" The answer came: "Thirty seconds to your target time," and Whitehead replied, "Red section crossing threshold now" as we entered the airfield area over the eastern end of the main runway.

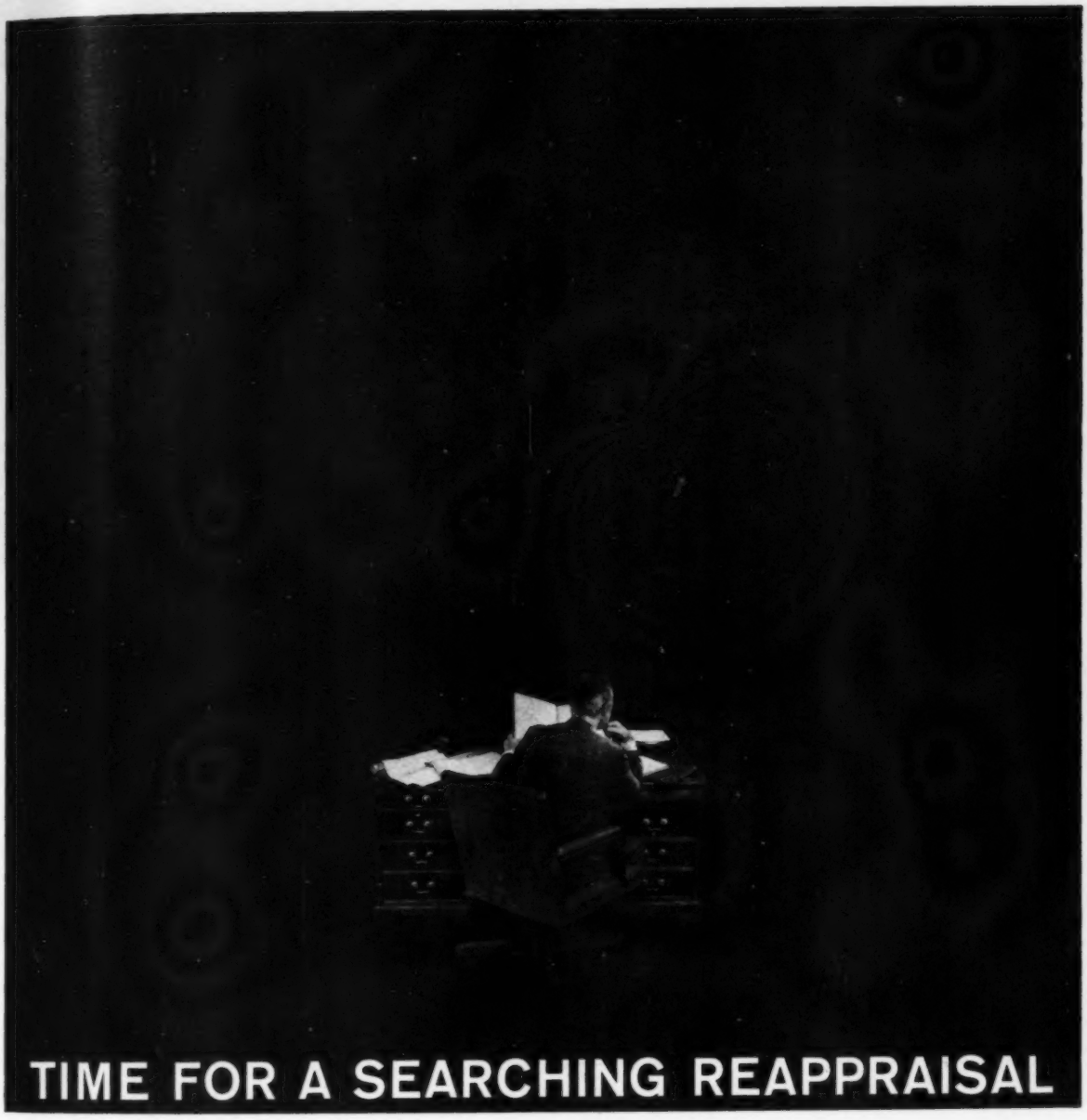
From the opposite end appeared the four Skeeters of "blue" section, and as Whitehead called "spread out" we passed through each other opposite to the president's enclosure. At the end of the runway we pulled up into a torque turn, performed with stick fully back and left "rudder" on. As we gathered speed in the opposite direction, Whitehead called: "Slowing down, go: stopping, go." Then we did an inwards turn towards the crowd and each section went into "clover leaf" formation, the four aircraft facing each other.

From clover leaf we formed echelon and did a backwards take-off; then went into a left turn (rather like closing a double gate), coming to face each other in line abreast. Forward again, spreading out so that the two sections could pass through each other; then again into line abreast, closing up in front of the spectators, after a second torque turn. Finally, bobbing up and down—odd numbers up, even numbers down, and vice versa; an outward turn and Whitehead's last instruction in the display: "Forward flight, go." And so back to Queen's Parade.

Saturday For brilliance of weather and of flying, this was the crown of the week: there was hot sunshine and blue sky in abundance, bringing out all the colours, and the pilots seemed to revel in the conditions. Special tribute should be paid to the Tiger Club for their delightful "Rainbow Nine" of Turbulents. These pretty little aeroplanes created just the right sort of show atmosphere for a sunny Saturday afternoon. Messrs. Trephewey, Gilbert, Griffiths, D. Phillips, P. Phillips, Dempster, Francis, Baring, Hutchinson, Jones and Miss McKellar alternating during the three public days, put on a most commendable show, supported by a lively commentary from John Blake. By contrast with Turbulence at near-ground level, 40 Bomber Command aircraft flew high above the airfield in a steady contrailing stream

Another unusual item which graced the public days was the Farnborough-rebuilt SE.5a flown today and on Friday by Gp Capt P. Hanafin, O.C. Experimental Flying, and on Sunday by Farnborough's Wing Commander Flying, Wg Cdr R. A. Watts.

Sunday This final day's display was carried out in dull weather, a great sheet of overcast covering the airfield at about 10,000ft, the effect presumably of a trough of low pressure forecast to cross southern England during the day. But the programme was not impeded, and the cloud gave the effect of a theatrical backcloth.



TIME FOR A SEARCHING REAPPRAISAL

In the light of current developments in air cargo, we challenge you to consider this statement. The time has come to make a searching reappraisal of air freight operations if they are being conducted with obsolete piston-powered passenger aircraft that have been converted for cargo. We are convinced that these aircraft, although they may still represent a multi-million dollar book investment, should now be disposed of, notwithstanding current market prices, and replaced by the modern all-cargo Canadair Forty Four. Inevitably, the disposal will result in a "profitable loss," because it can be shown that the Forty Four is the only all-cargo aircraft able to operate at a profit, either domestically or internationally, under the new low freight rates and will recover in a short period of time the losses incurred on the sale of the outmoded converted equipment. Any General Dynamics or Canadair official would welcome the opportunity to discuss this in more detail.

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"Who can tell me this?" said the M.D. with a superior smile. "If one man with one tool can tighten one nut, how many men would you need to tighten eight nuts?"

"Couldn't it be a woman, sir?" asked one Little Horse who had been reading Lolita under the desk.

"Depends whether it's at overtime rates," said the pedant of the class.

"Wrong, wrong," cried the M.D. triumphantly, "you're all wrong! The answer is NONE, because it's a Desoutter eight-spindle multiple nutrunner, controlled by Lang Pneumatic Valves and built by Carter Stevens into an automatic machine!"

"I think schoolmasters are grossly overpaid!" said one Little Horse after a long blank silence, "let's go on strike."

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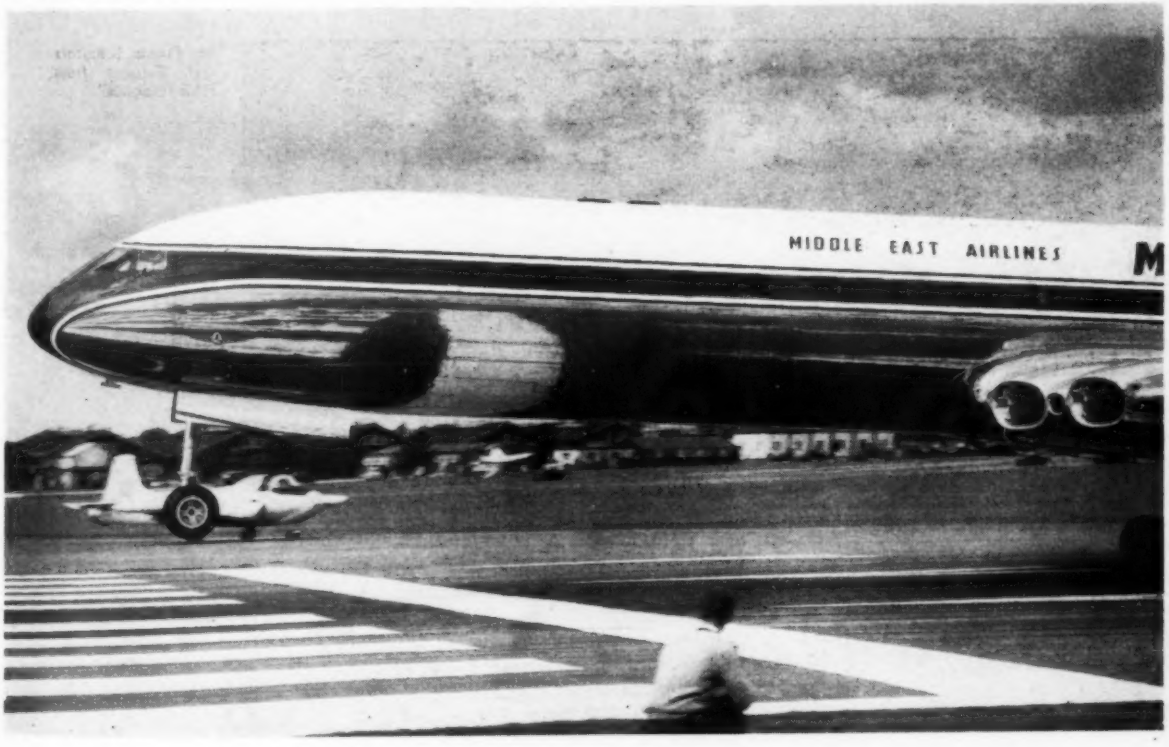
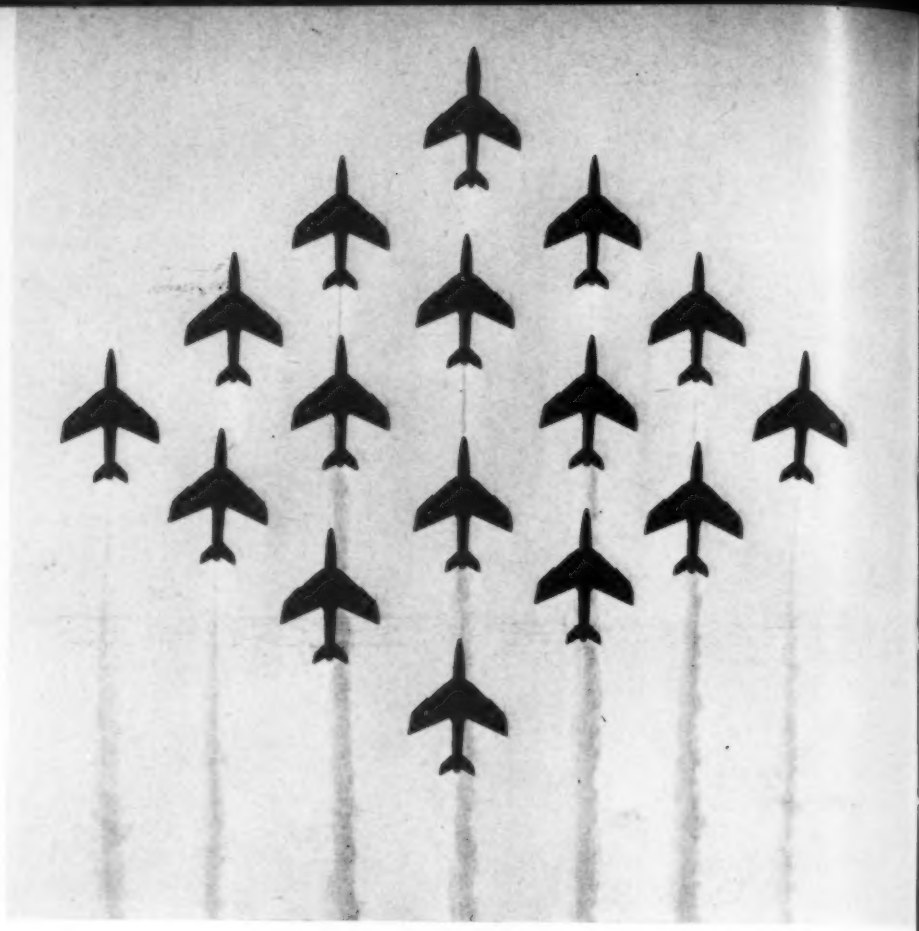
Where every prospect pleases . . . *The Hunters of 92 Sqn*

FARNBOROUGH WEEK . . .

. . . and only man is vile *A photographer gets down to work on the Comet 4C*



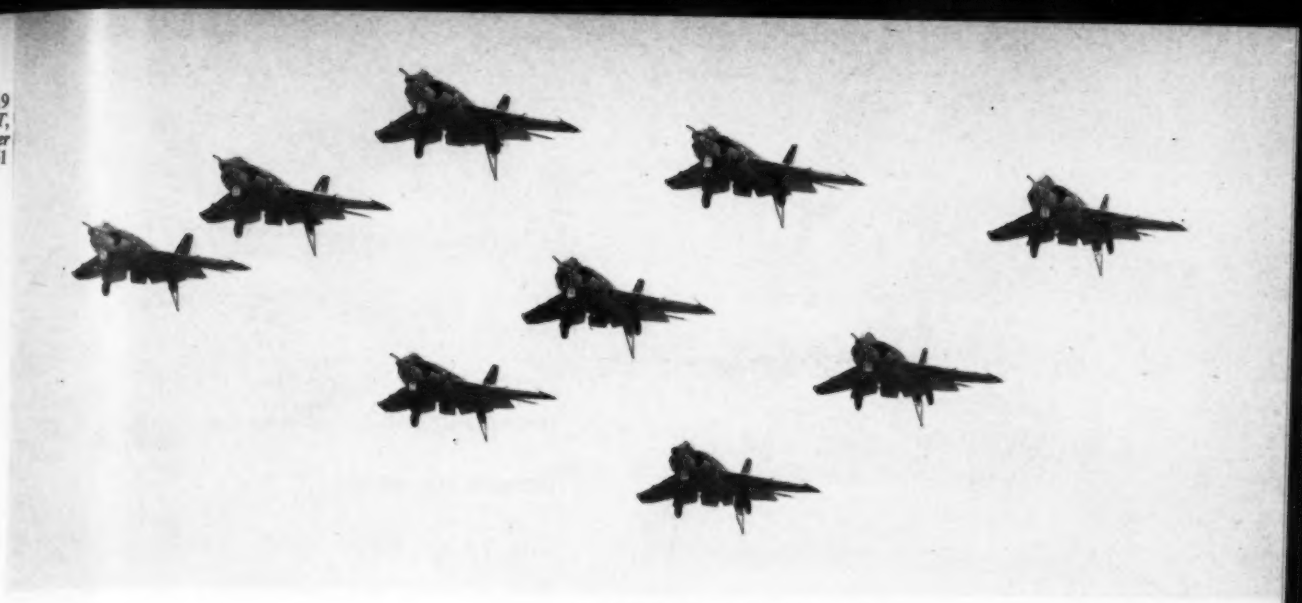
FARNBOROUGH WEEK . . .



The Hunters of 92 Sqn, RAF Fighter Command

CONCERTED ACTION

Sea Vixens, Scimitars and Gannets from HMS "Hermes"



The Scimitars of 800 Sqn, Fleet Air Arm

Below, the Lightnings of 74 Sqn, RAF Fighter Command

Above, Jet Provosts of the Central Flying School, RAF Flying Training Command

Below, Whirlwinds of 38 Group, RAF Transport Command

The Belvedere as an assault craft

The Sea Vixen as an in-flight refueller

The Gnome Whirlwind as a crane-transporter, with the Wessex waiting to function as a tug

The Wessex as an automatic submarine-detector

FARNBOROUGH WEEK . . .

The Trade Days

WITH Monday's technicians and the Press out of the way, Farnborough set about welcoming the industry's invited guests on the damp morning of **Tuesday, September 5.** The Army insisted on first things first: at a refreshment lorry near the Thunderbird park a mass of soldiery claimed their pre-work char and wads; while at the top of the hill a corporal was slowly, carefully painting the rear left-hand tyre of the Malkara vehicle with Holt's Autotop Extra Heavy Black Dressing.

On behalf of the Minister of Aviation, Mr Peter Thorneycroft, his Parliamentary Secretary, Mr Geoffrey Rippon, announced during the morning that it had been decided in principle to order five VC10 aircraft for use by RAF Transport Command. This brought the total number of VC10 orders to 57.

Connoisseurs of Soviet Press conferences become connoisseurs also of the Russian art of skilful evasion. However, it is always something for a news conference even to be granted to the Western Press; and it was gratifying indeed that three distinguished men of Soviet aviation, Ilyushin, Antonov and Leschenko, should have agreed to meet journalists in the SBAC President's enclosure on the Tuesday afternoon. Mr Sergei Leschenko is chief of the state commission for the Soviet aircraft industry (equivalent perhaps to our Minister of Aviation), and of course Mr Sergei Ilyushin and Mr Oleg Antonov are designers of international eminence whose names are associated with, in particular, a competent line of transport aircraft.

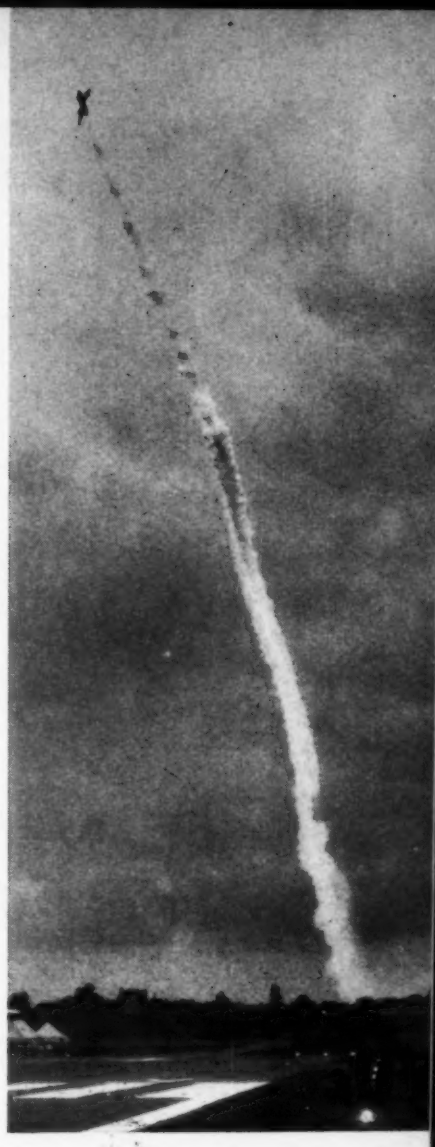
One of the first questions, inevitably, was about civil supersonics. The delegation was asked about Soviet plans in this field, in view of the fact that British designers were aiming for Mach 2.2 and American designers for Mach 3. Mr Ilyushin's answer, given through the interpreter, was: "All countries are at the planning stage. It is difficult to forecast; it is a question for investigation." What about VTOL? The answer was that, in the Soviet Union, "our designers are working on many types of aircraft." With what aircraft in the SBAC show had the delegation been most impressed? Mr Antonov said he had been most interested in the Avro 748. How did this aircraft differ from his own An-24? The answer was that one had a low wing and the other had a high wing. Was the An-24 in service yet? No, not yet.

One of the first questions was how Russian aviation compared with British aviation. The diplomatic answer was: "Some of our things are better, some of your things are better. Our aviation is not worse." To the rather vague question "What are you doing tomorrow?" (which was presumed to mean "What are Soviet designers' plans for the future?") the answer was: "Our designers are working hard just now."

The delegation was asked who designed the E-66. The answer, given by Mr Leschenko after some thought, was "Mikoyan." When a resourceful member of the Press held up a photograph of the E-66, and asked for verification of its identity, the reply given by Mr Leschenko after some hesitant grinning was: "A lot of aircraft were shown at Tushino. We can't explain everything."

What was the future of Decca with Aeroflot? This was not, Mr Leschenko replied, a question for the delegation but for Aeroflot. Was Russian aircraft production predominantly military or civil? "Civil, definitely," was the prompt answer. *Flight* asked whether the Soviet delegation was to visit British factories and whether British designers would be invited to visit Soviet factories. The answer was that no invitation had been received yet to visit British factories. The second part of the question was not answered.

Asked what was the future of the manned fighter, the delegation replied that all those present were concerned with civil aviation. Was the delegation interested in the VC10? Yes, this was a very interesting design. Why, the delegation was asked, did the Soviet Union have no four-jet airliner? "We have the Tu-110," was the reply—surprising to those who thought it had been abandoned



some time ago. Pressed to say when this aircraft would be in service, since nothing had been heard of it since a photograph of it was first seen some four years ago, the answer was: "It is at an experimental stage." Yes, but when would it go into service? Answer: "It will go into service when it is necessary for our national economy."

A question that might have been considered tactless and inappropriate, but was not, was answered very frankly. Could Mr Ilyushin dispose once and for all of rumours that his son was injured while attempting to make the first manned space flight? Mr Ilyushin listened gravely to the question while it was interpreted, and then grinned broadly. The interpreter gave the answer: "This was the first question that was asked of us at the airport yesterday. Mr Ilyushin's son, who is one of the Soviet Union's finest test pilots, was unfortunately involved in a car crash near Moscow airport and injured his ribs and leg. It was unfortunate, because he is a fine test pilot, but he is getting better."

Above, putting the light in Lightning

Right, marking the progress of the Hunter Two-Seater

On the morning of **Wednesday, September 6,** second of the trade days, our corporal had reached the front left-hand wheel of the Malkara vehicle with his tin of Extra Heavy Black Dressing. At the bottom of the hill a genial Mr Thorneycroft was being interviewed by the BBC, carelessly slipping in after the Farnborough platitudes the new official fact that West Germany would be making the third stage of the proposed Anglo-French-German space launching vehicle. As to the prospects of this proposal going ahead, Mr Thorneycroft remained, as ever, hopeful.

The breeze was sharp on enclosure row D, ruffling the Café Royal napkins on the tables in the Hawker Siddeley Aviation enclosure and chilling the gins in the hands of the group of hard-working journalists there assembled to hear news of a £1m order for Bristol Siddeley Viper 20 turbojets. These would power the de Havilland D.H.125 six-seater executive jet aircraft, the first customer for which was to be the Bristol Siddeley company. The first D.H.125 (the company does not now wish to commit itself to the name Jet Dragon) will fly by June 1962, the managing director of de Havilland Aircraft stated, with deliveries beginning early in 1963.

On the morning of **Thursday, September 7,** the sun shone for the first time during Farnborough week, illuminating sharply the completed black beauty of the Malkara vehicle's tyres. Inside the exhibition tent, most people homed on to the rotating red beacons on the Beagle stand at one time or another, to inspect the trio of trim interiors there displayed. At the recruiting booths near the main access road from Gate B, techniques varied: the Navy showed a colour film of carrier operations, while the Army dispensed "Oh, what a beautiful morning" over a loudspeaker, displaying the while pictures of a Special Air Service enthusiast up to his chin in a Malayan swamp.

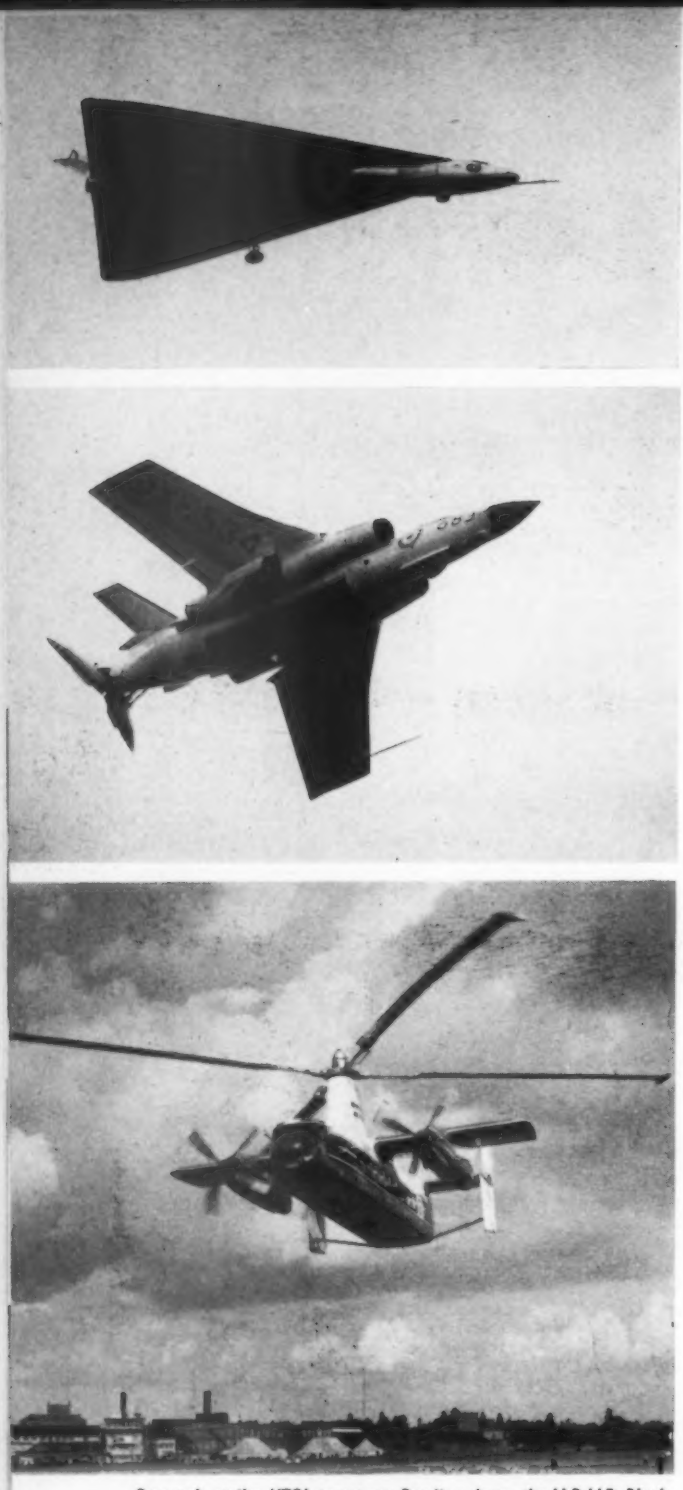
Below, Martin-Baker's latter-day Elijah

At 11.30 a.m. Mr Peter Masefield came to the Press tent to tell us that Beagle had so far received firm enquiries at Farnborough to the tune of just under £1m, relating to over 25 B.206s, 20-25 Airedales, 20-25 M.218s and M.117s, and over 20 Terriers. About 50 per cent of these enquiries had come from abroad, and in particular from Australia, New Zealand, South America, France and Germany. After the SBAC show, Mr Masefield declared, Beagle would "add up the interest and decide a production rate"—which he hoped would be a Beagle a day before long.

At 1.30 p.m. the Press came to Handley Page to hear that the Italian airline Itavia had ordered two Heralds with an option on a third, and that Maritime Central was to take up one of its existing options on the aircraft. Itavia deliveries would be in January and February, 1963. Also announced was the delivery of a de Havilland Dove 7 to the United Arab Republic for survey and communications work.

The Flying Display

On each of the three trade days the majority of items in the flying display were presented, in damp weather on Tuesday, cold and damp weather on Wednesday and—much to the satisfaction of organizers E. C. Bowyer and H. W. Goodinge—near-perfect,



Research, strike, VTOL transport: Reading down, the H.P.115, Blackburn Buccaneer S.1 (in its new white paint scheme) and Fairey Rotodyne prototype (in its new Service markings)

FARNBOROUGH WEEK . . .

fresh and sunny conditions to mark the Society's 100th display on Thursday.

The Royal Air Force accounted for 32½min of the programme, including the aerobatic displays, parachute jumping, and "a large-scale demonstration of tactical transport operations." This last began with a simulated attack on the airfield by two quartets of Hawker 9s from 54 Sqn, followed by the landing of an assault party from two Belvederes and four Whirlwinds. As the troops shinned down ropes from the hovering helicopters, the Hunters maintained a combat air patrol and loud bangs came from a sound-effects man in the background.

Four Beverleys were next to arrive, disgorging troops, guns and vehicles. The assault troops were then supplied with miscellaneous further supplies by the helicopters and by a Pioneer and Twin Pioneer. The two aeroplanes then landed for a simulated casualty evacuation, after which the entire cast of aircraft took off and headed towards Laffan's Plain, while an Army bugler played "No Parade To-day" (stand-down).

So much for the circus, now for the flying. Nothing in the show exuded more sheer power than the three-second-interval stream take-off by the nine Lightnings of 74 Sqn, beating down the runway in a sustained blast of brown dust and stomach-shaking noise. As the rear machines were taking off, the leaders were climbing an invisible, vertical wall over Laffan's Plain. All were airborne in 35 sec.

By contrast, the 16 blue Hunters of 92 Sqn were positively relaxing. Beautiful aircraft in a perfect formation, they eased into a loop in Diamond 16, white wingtips shining together as they curved over the top. Wingovers, rolls, and a neat change to the novel Diamond T formation—seven in line abreast, with a Diamond 9 behind.

After the Hunters, the Lightnings were on stage, smoking in towards the airfield in arrowhead formation, changing to Diamond 9, and including wingovers and a roll in their programme. A split into three echelons preceded the final run-in and break for landing. Earlier, synchronized aerobatics had been effectively executed by two pairs of CFS Jet Provosts, and free-fall parachute jumps were made from three Auster 9s (22nd SAS Regt.) and a Beverley (instructors of No 1 Parachute Training School, Abingdon).

Between the assault demonstration and the Lightnings' formation drill, there was a varied selection of individual and formation displays by company-presented and Service aircraft. First came the Comet 4C, Gyron Junior Javelin, Argosy C.1, Olympus Vulcan and Jet Provost, together with the hard-working helicopter quartet comprising Belvedere, Scout, Wessex and Whirlwind. On Tuesday and Thursday the Rotodyne also appeared.

The spirited intermeshing of the Army's eight Skeeters, barn-dancing, formating backwards and not-quite-head-on charging in two groups of four, was followed by a stylish solo act by the two-seat Hunter flown by Bedford on Tuesday and Wednesday and by Lockspeiser on Thursday. Immediately after take-off, a roll with gear still down began the performance, the later highlights of which were a diving roll to near-ground level, and a white-smoking run along the length of (and only just above) the main runway.

Impressive Pack of Beagles

The Beagles were impressive, particularly the appearance and docility of the B.206 and the low-speed handling of all four types. Folland's Gnat Trainer, Avro's 748 (seemingly jumping into the air on take-off) and the Blackburn Buccaneer followed, the all-white Buccaneer displaying some fast rolls and tight circuits. Handley Page's Victor and Herald preceded the still-remarkable sight of the SC.1, extremely steady in its two transitions.

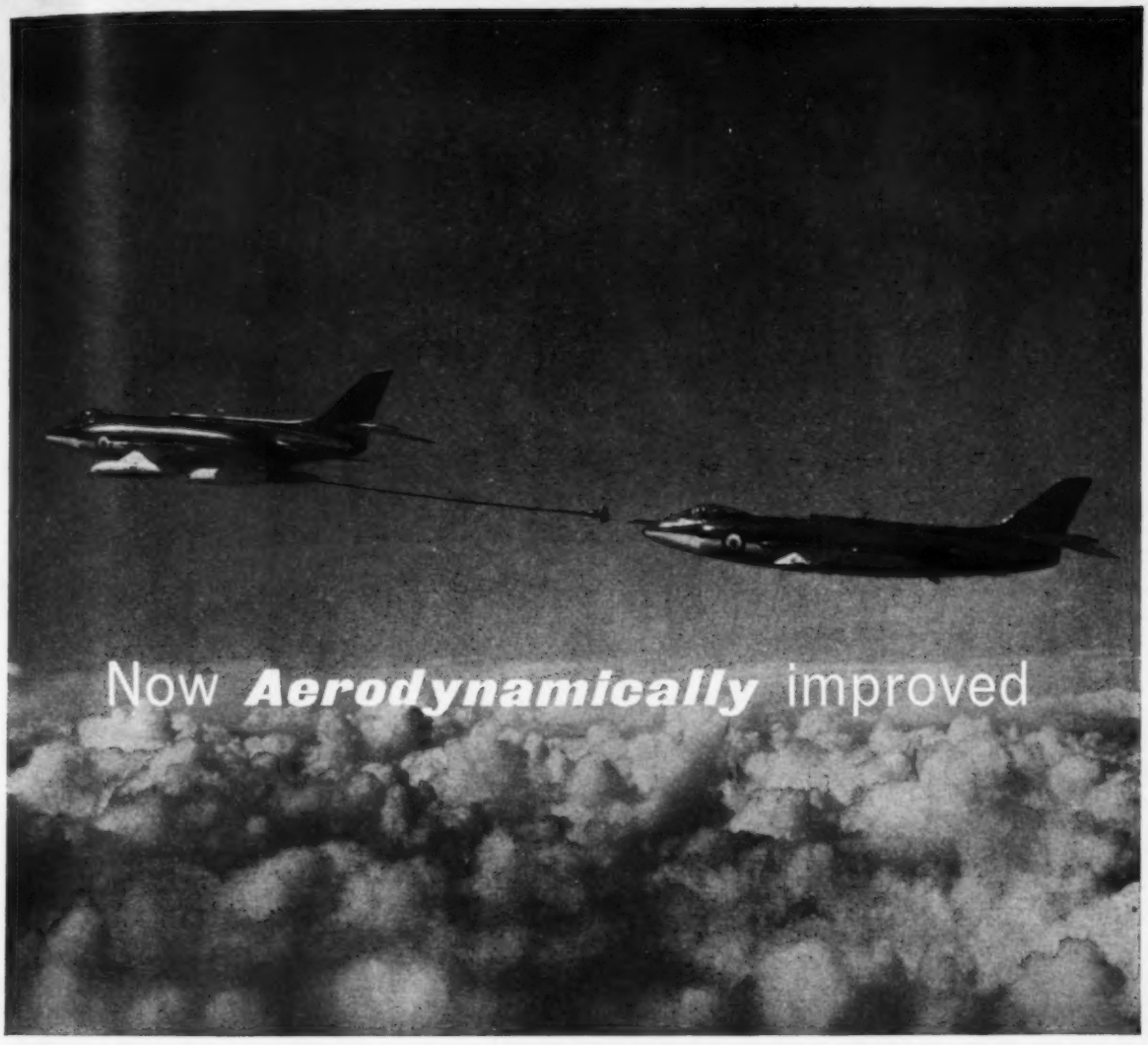
Four further items remained, each one exceptional in a different way—the Martin-Baker rocket-assisted ejector seat, the paper-dart shape of the H.P.115, a Lightning T.4 demonstration and the Royal Navy's contribution. Beamont (Tuesday) and Dell (Wednesday and Thursday) once again produced a near-incredible display of tight, high-g turns in the Lightning, this year's speciality being the judicious application of re-heat seemingly to jerk the aircraft around the corners with a bang.

But, on each of the three days, it was the Navy which stole the show, with a combination of originality, flying skill, and professional split-second timing. The crisp timing, in particular, was nowhere near approached throughout the rest of the flying display.

Curtain-raisers to the Navy's show were low runs by a Scimitar and Sea Vixen, and by two Sea Vixens engaged in "buddy" refuelling. Then the unforgettable entrance of the nine Scimitars of 800 Sqn—not fast and swooping, approaching head-on towards us, but suddenly, from over our shoulder, slow and rock-steady in Diamond 9 and with everything (gear, flaps and hooks) down.

With the Sea Vixen buddy-boys disengaged and away back to Yeovilton, 800's Scimitars pulled out all the stops—rolls, a loop, formation changes, a break into five and four, solo runs, tight turns, a final bomb-burst and on into a stream landing. A zingy, swinging show based on beautiful flying and few gimmicks. To round off the Navy's contribution, in came the Gannets, Sea Vixens and Scimitars from HMS *Hermes*, the Gannets presenting their one and only gimmick by each shutting down one-half of its Double Mamba as the formation passed the President's enclosure.

During Thursday's display, Soviet visitors Ilyushin and Leschenko paid a visit to the Press tent and gathered up every available handout, brochure and photograph from the companies' publicity desks. After the display, Mr Antonov was taken for a demonstration flight in his favourite British aircraft, the Avro 748.



FR MK20 Refuelling Pack

* **COLLAPSIBLE DROGUE** *folds when fuel hose is retracted*
* **MORE COMPACT POD** *which houses folded drogue*

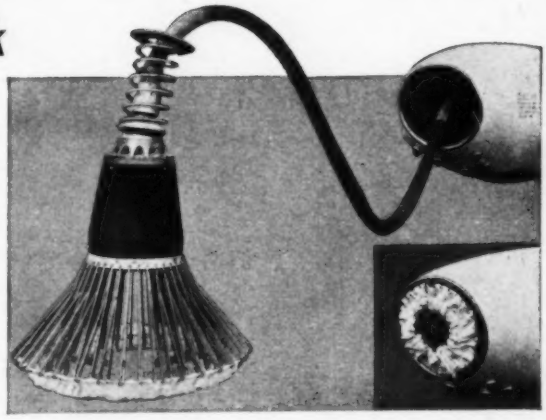
The FR Mk 20 Refuelling Pack—the unit that rapidly converts a fighter into an aerial tanker—now incorporates two major modifications which result in a more compact, more streamlined shape for the pack, with correspondingly less drag.

This unit is capable of refuelling another aircraft at a rate of flow of 150 gallons per minute at a constant 50 p.s.i.

The pack is designed to accept fuel from the carrying aircraft to supplement the supply required by the receiver aircraft. Should refuelling not take place, fuel from this pack can also be used to augment the carrying aircraft's own supply. Jettisoning is provided for emergency conditions.

Illustrations show Scimitar-to-Scimitar refuelling with the Mk 20 Unit (photo by G. Woollard of Vickers-Armstrongs, South Marston) and the pack during ground testing at Tarrant Rushton (note photo showing drogue folded and stowed).

The Mk 20 Unit is scheduled to go into service with SCIMITAR and SEA VIXEN aircraft of the Royal Navy.



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In open competition with the best weapon systems available in the West, and strictly on technical and operational merit, the Bristol/ Ferranti Bloodhound Mark 2 has been chosen by Sweden and Switzerland. This powerful, accurate and air-transportable weapon system has also been ordered by the Royal Air Force as the basis of Britain's anti-aircraft defence.

Bloodhound Mark 2 is a second-generation missile system and is the logical development from Bloodhound Mark I.

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- **Long range**
- **High and low altitude coverage**
- **Extended performance in all aspects of anti-aircraft defence**
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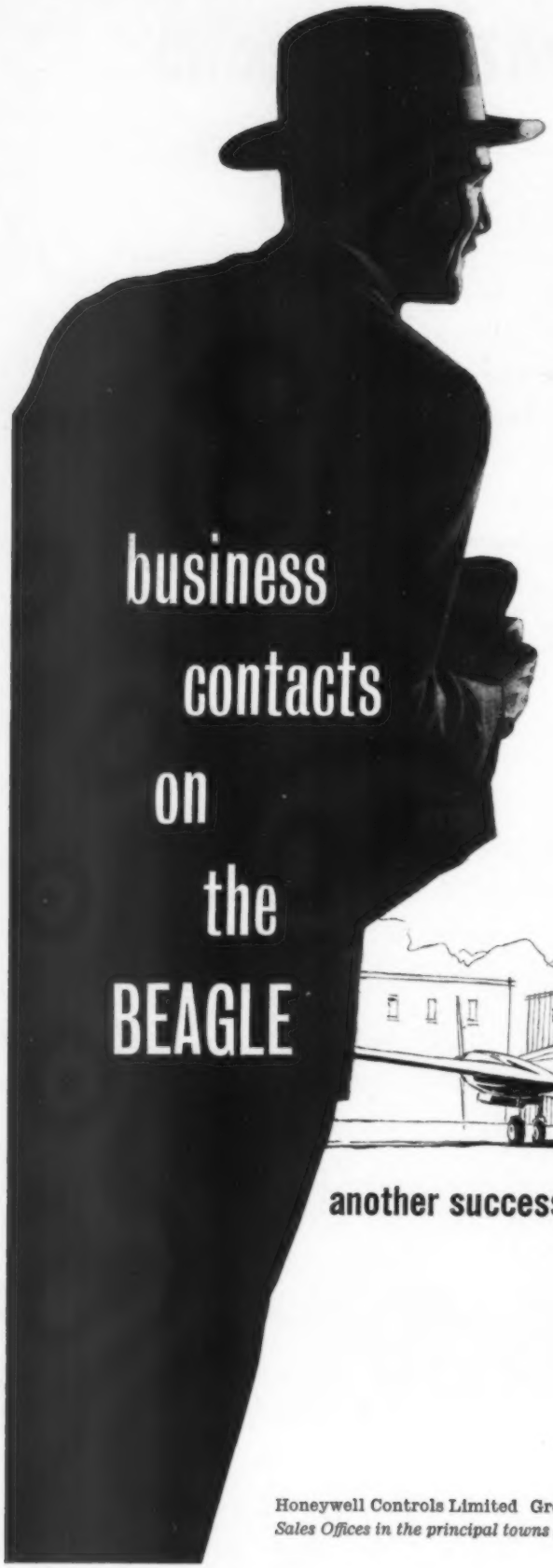
BLOODHOUND

MARK 2

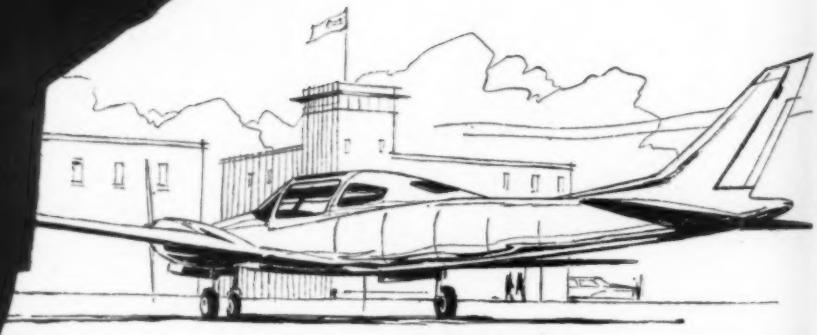
F CORPORATION

BBW.4



business contacts on the BEAGLE

Whether the pilot requires contact to be made many times a minute or a few times an hour, his call is answered precisely, surely by Honeywell's tiny snap-action devices.
On the newest executive aircraft—the Beagle B.206—they are located in 16 critical positions, where their functions include undercarriage lock, cabin door lock and tail trim actuation.
The 'business end' of vital circuits in virtually all leading aircraft, Honeywell Micro Switches are a lasting success wherever they are used.



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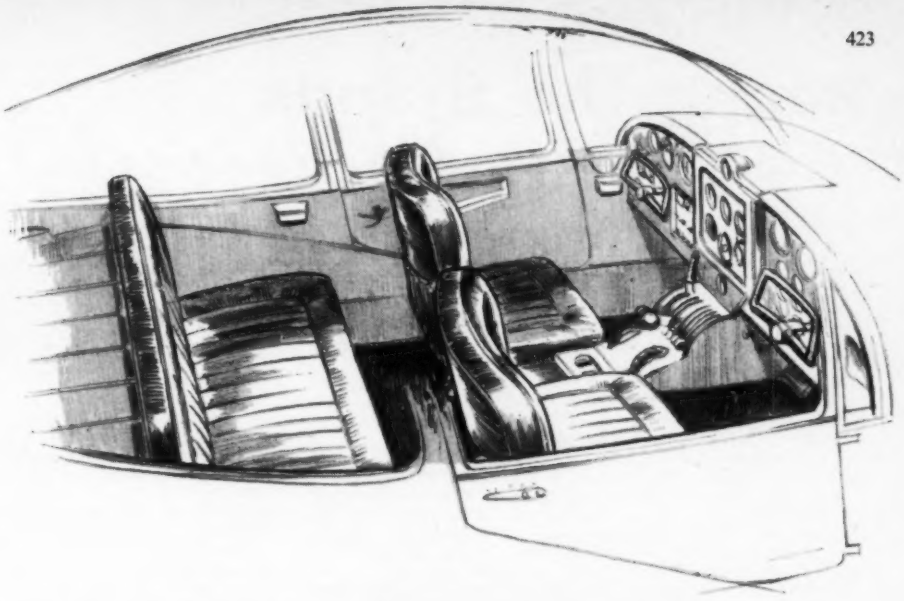
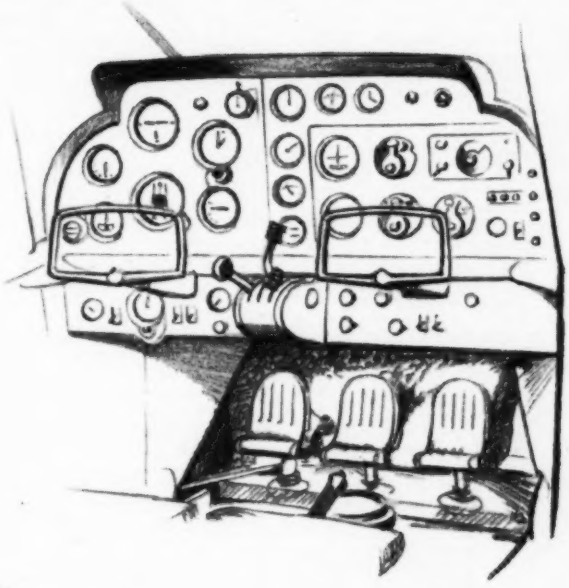
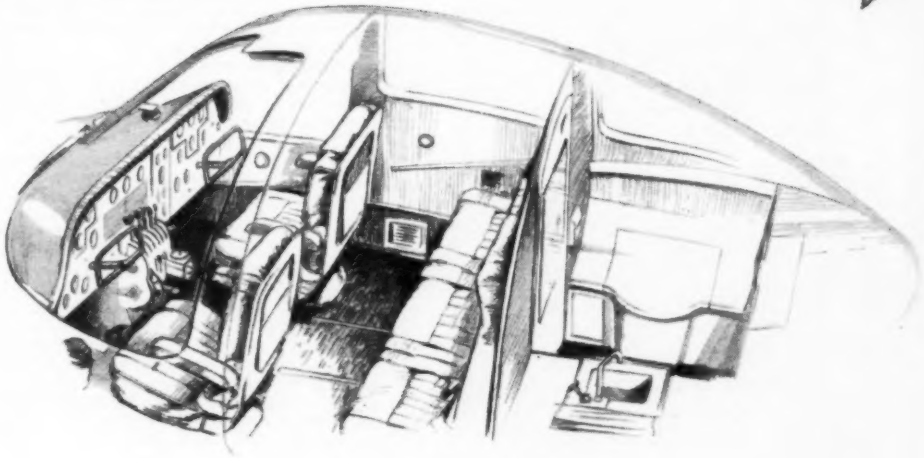


Looking into the Beagles at the Show

BEAGLE have given a tremendous fillip to everybody interested in British aviation. At the SBAC Show last week their new aeroplanes could be seen in the air, and there were mock-ups and models of other good aeroplanes soon to come. The small illustration is a new impression of the Beagle-Miles M.117 (the 145 h.p. version, with retractable undercarriage); the others, by "Flight" artists, show three new interiors. Above is that for the four-seat Beagle-Miles M.218, which is essentially a twin-engined, 200 h.p. version of the M.117; on the right is an impression of the production cockpit of the Beagle-Auster A.109 Airedale; and below is the accommodation of the Beagle B.206: five seats plus bar and toilet





Round the Stands

—at the SBAC Exhibition

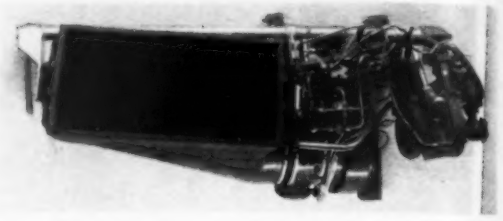
Air Conditioning

A first impression of air-conditioning and pressurization equipment seen at the show leads to the conclusion that, this year, systems have become more complicated; or as their manufacturers are claiming, more refined. The exhibition enclosure provided a number of firms —particularly including the specialist big two, **Sir George Godfrey and Partners** and **Normalair**—with a chance to show their hardware for the big VC10. Some units, such as Normalair's 15-ton refrigeration capacity cooling pack (still in the prototype stage), were actually still partly in wooden mock-up form, but altogether nearly all of the VC10's air-conditioning system was on show.

Under Vickers direction, this aeroplane is providing component manufacturers with an opportunity to produce an air-conditioning system which should be the best yet on either side of the Atlantic. Of the three basic methods of supplying a pressurizing and conditioning airflow—tapping bleed air, driving a compressor mechanically, or driving it by a bleed-air turbine—Vickers have selected a mechanically-driven compressor, mentioned last week in the report on the RCo.42/1 engine. Supplied by Godfrey, this compressor is basically a much-developed version of the Godfrey/SRM screw-type cabin-supercharger applied to the Vanguard; but it incorporates a sensing system and, unusually, the gearbox is of Godfrey design. It includes an oil pump and an independent oiling system, supplying oil at low pressure for lubricating the gearbox and at high pressure (250lb/sq in) for adjusting slide valves which control the effective length of the rotors and the opening and closing of a spill duct. These hydraulically operated valves move in a longitudinal slot in the rotor chamber, where they are adjusted in respect of mass-flow signals from venturi nozzles and pneumatic pressure-sensing units downstream of the bifurcated outlet duct. Error signals from the signalling unit are generated by an a.c. rectilinear pick-off, transmitted to an amplifier and thence to torque motors on hydraulic control valves which in turn adjust the slide valves.

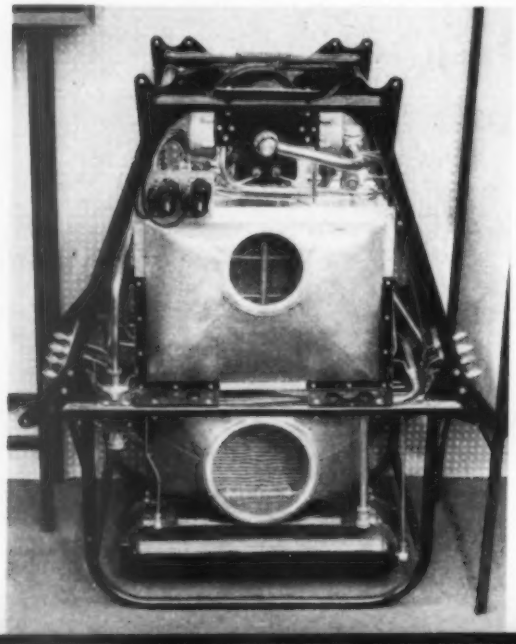
All this means that when output is high, but air demand is low—as it is at take-off—three-quarters of the intake airflow to the compressors is spilled overboard, greatly reducing the power consumption of the two compressors. On the climb, the effective length of the rotors increases with movement of the slide valves, less air is spilled overboard, and delivery is increased. Maximum airflow is delivered when the aircraft reaches 40,000ft, at which height the spill valves are fully closed. Four units of this type are fitted to each VC10.

Another method of doing the same job—spilling unwanted compressor-delivery air overboard when drive speed is high, but altitude low—has been developed by Normalair for the Franco-German C.160 Transall. In this design, which is believed to be quite novel, an automatic clutch decreases the speed of the compressor as the drive speed goes up, thus reducing power demands upon the main engines at times when accessory power take-off must be kept to a minimum. A sectioned transparent-plastics model of the unit, several times full size, was a central exhibit on Normalair's stand.



Normalair's largely self-contained Freon refrigeration system for the VC10, with air-turbine/compressor on the right

Probably the largest single piece of air-conditioning equipment yet developed for a British aeroplane is this vapour-cycle package by de Havilland Aircraft (ex-D.H. Propellers) for the Belfast



Other development work by this manufacturer has been concerned with improving pressure-sensing devices in the cabin, so that the effects of engine power surges are reduced. Inevitably, they have turned to electronic pressure controllers to increase system reaction speeds, capsule movements in response to pressure changes being translated into electronic signals which are used to adjust the position of the outflow valves. Nevertheless, pneumatic, rather than electric, final actuation of discharge valves is still favoured, since a balanced pneumatic valve is less sensitive to dirt accretion and, in particular, to the build-up of nicotine deposits. Further advantage of pneumatic operation is that the valve slams shut should the signal fail; fail-safe design with electric actuation is less straightforward.

A number of electronically signalled valves were on show, all basically similar to the pneumatically signalled types which preceded them. The change-over is, of course, by no means complete, and for simpler types of aircraft than the VC10 all-pneumatic operation is still preferred.

More VC10 equipment on Normalair's stand was the cooling pack, one of which is incorporated in each wing leading edge. This is the first Freon air-conditioning unit for a British civil aircraft, and it comprises a refrigeration circuit with a large heat-exchanger cooled either by ram air or by a fan when the aircraft is at rest.

De Havilland are now another big name in air-conditioning, manufacturing not only the system for the Trident, but being responsible for the Short Belfast system as well. For their own aircraft, D.H. are using bleed air, the air-conditioning output being supplemented by an a.p.u. supply when the aircraft is on the ground, with a ground connection as well.

Air from Spey engines 1 and 3 passes through individual circuits comprising initiation valve, mass-flow controller, heat exchanger, a dual temperature control valve with a by-pass through a cold-air unit, and then into the interior of the aircraft. Individual water-separator/silencers control air to the flight deck and to the main passenger cabin. All punkah-louvre air is taken from engines 2 and 3, tapped downstream of the temperature control valve and passed through a louvre-temperature control valve where it is mixed with a tapping from one of the twin cold-air units.

Focal point of the Belfast system (illustration at left) was the self-contained vapour-cycle refrigeration pack, slung in a special frame. Belfast and Trident systems are quite different, as might be expected from the respective choice of powerplants. Belfast air-conditioning and pressurization air is supplied from two engine-mounted blowers, the output from which passes through a mass-flow control (with excess-flow and excess-pressure sensers) into a silencer, system spill isolation valve, and into the pressurized zone. Both aircraft systems were set out diagrammatically on the stand, flow- and pressure-sensing lines being indicated by lighting.

More VC10 equipment appeared on the **Plannair** stand. For this aircraft, the company are producing a new range of blowers; the largest has a capacity of 880 cu ft/min and is used for cabin-air recirculation. Other units are designed to cool the radio rack (there is a stand-by blower in case of motor failure), to ventilate toilets and galleys, and to boost air supplied to the louvres. The last design incorporates sound-deadening features, and the non-stall impeller is covered by patent applications.

Finally, exciting developments are taking place at **Teddington Aircraft Controls,** who are negotiating to build Ateliers SEMCA air-conditioning units under licence. Nearly all French pressurized aircraft have been supplied with SEMCA air-conditioning units in the past ten years, among them the Mirage III and Breguet 1150 Atlantic. Teddington list their best features as simplicity, efficiency and low weight and cost, and are proposing a Teddington SEMCA system for the Jet Provost.

Electrics

INCREASING use of constant-frequency a.c. systems in both civil and military types of aircraft is reflected in the number of constant-speed alternator drives to be seen this year at Farnborough. This continues the trend which became marked in 1960.

A newcomer to the field in this country is the Lycoming friction drive, which is to be manufactured by **Rotax**, under licence from the Avco Corporation of America. Operating on the Hayes gear principle, an interesting feature of the Lycoming drive is the fact that torque is transmitted by friction contact between toroidal-shaped discs and rollers. It is apparently simpler than other types of constant-speed drive, and some of the American tests have been run at oil temperatures up to 365°F. The development of this unit will doubtless be followed with interest. A number of models with ratings between 10 and 40kVA have been built and tested, one example being a 20kVA drive capable of accepting an input speed range of 2,300 to 8,500 r.p.m. and weighing 65lb complete with control equipment.

Plessey were exhibiting their differential air drive, which also provides facilities for starting the propulsion engine and motoring over the auxiliaries during ground-checking. Since its first appearance last year, further development has resulted in changes to the control system, with the deletion of one of the control valves. The unit is now also arranged to be self-contained by the addition of an oil system for lubrication and operation of the governor servo-controls.

Other pneumatic types of alternator drive employ radial or axial-flow air turbines. An ideal application for these is the emergency power source, ram-air driven, to feed the vital loads of an aircraft in the event of power failure due to engine flame-out or fuel shortage. Such units are made by Plessey and **Dowty-Rotol,** the latter supplying the ram air turbines for the VC10. These are arranged to swing into the airstream automatically, one unit driving a hydraulic pump and the other a Rotax 15kVA alternator. Dowty-Rotol also showed their 15kVA turbo-alternator unit intended to be driven by engine bleed air, in which the turbine rotor and alternator are mounted on a common shaft.

From their display, it was apparent that the Aircraft Equipment Division of **English Electric** have adhered to the basic principle of the differential hydro-mechanical unit which is in worldwide use and which they licensed from Sundstrand. From the new 38 h.p. (30kVA) unit on display, it appeared that much has been done to achieve a compact design, which weighs 62lb. Although the unit shown did not incorporate an oil tank and cooler, it is understood that a complete oil system is available, which attaches to the basic transmission unit to make up a self-contained package, of total weight 90lb, including oil.

Also on show were the working components of a unit which had just been removed from a BOAC Boeing 707, for a routine overhaul. At the time of writing this takes place at 1,600hr, but it is expected that approval will shortly be obtained to increase the time to 3,000hr.

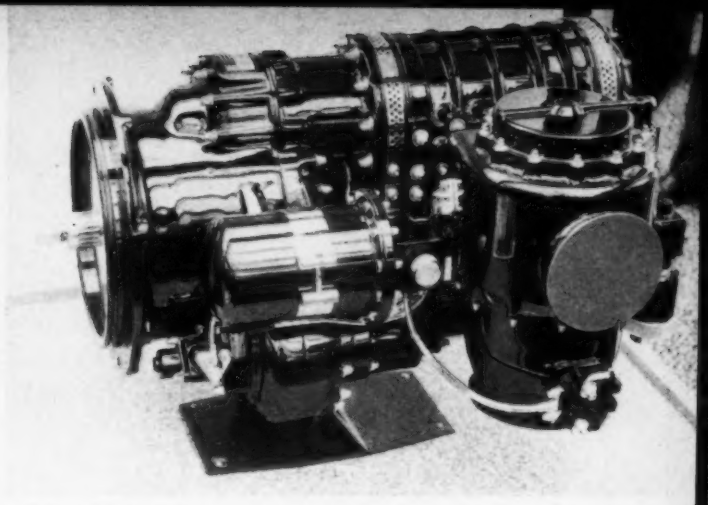
The other hydro-mechanical drive to be seen was on the **Hobson** stand; it is rated at 35 h.p., and weighs 89.5lb complete with integral oil system. This unit, scheduled for the Trident airliner, has now completed engine type-tests and initial system tests. Tests run during the past year appear to justify the manufacturer's original aim to achieve an overhaul life approaching 2,000hr.

Plessey again exhibited the Labamatic constant-frequency alternator unit which they have licensed from the French firm Labinal. This operates on the slip principle, and appears to be particularly suitable for small-power applications. The unit shown was rated at 4kVA and weighed 72lb complete with alternator, two-speed gearbox, and the frequency and voltage control unit.

Equipment shown this year reflected the designers' aims to reduce the number of moving contacts and other components to a minimum. Examples of this were to be seen in the several types of static inverter shown by **Ekco, Elliott Brothers, de Havilland** and **Westinghouse Brake and Signal**, as well as by the generating equipment manufacturers Rotax and Plessey.

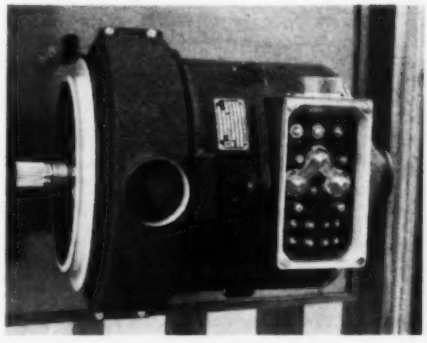
Rotax have units rated at 1 and 3kVA, and they were also showing a new three-phase contactor employing silicon controller rectifiers. Doubtless we can expect this development to be followed by a general move to eliminate moving contacts in the heavier duty applications as well as light current circuits. Also on the Rotax stand was a channel of d.c. generating equipment as used on the Wessex. This features a solid-state voltage rectifier employing a combination of the magnetic and transistor amplifier principles.

Alternators designed on the inductor-rotor principle, avoiding the need for electrical windings and rectifiers on the rotating assembly, were also shown by Rotax, an example being their 55/30kVA machine. A positive example of the work being done to enable electrical equipment to operate at higher temperatures was the exhibit of an a.c. motor stator completely insulated with p.t.f.e.

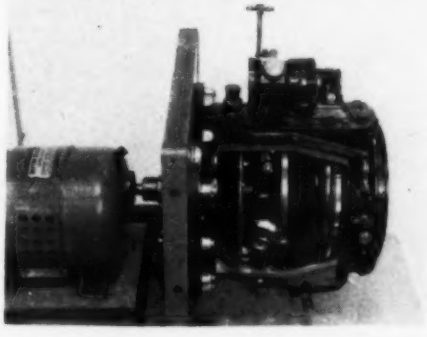


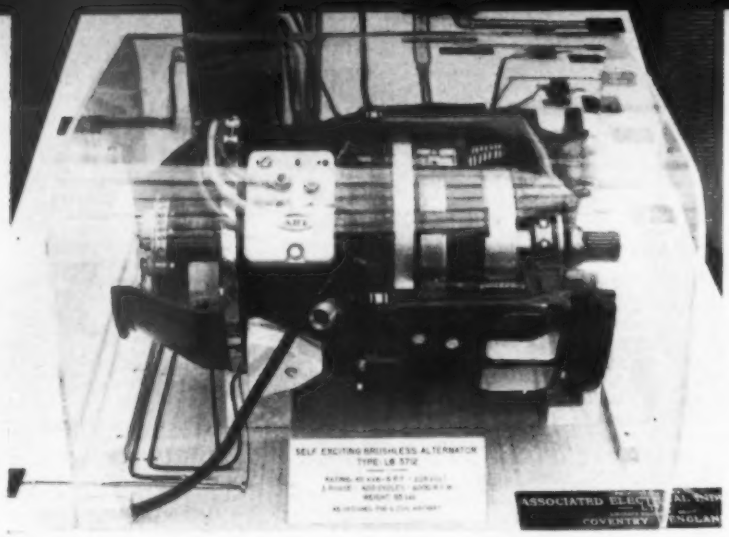
The Plessey differential air drive, modified this year and now chosen for the BAC One-Eleven airliner

An example of a trend; a static-contactor by Rotax, passing 16A of three-phase current at 208V



Above, the Rotax 55/30kVA, 208V, three-phase solid-rotor alternator; below, the new, Rotax-Lycoming drive





Partially obscured by acrylic plastics, this AEI self-exciting brushless alternator is rated at 40kVA, 208V, 6,000 r.p.m., and weighs 95lb; it is "designed for a civil aircraft." Below, right, is another new static inverter, this time by Plessey

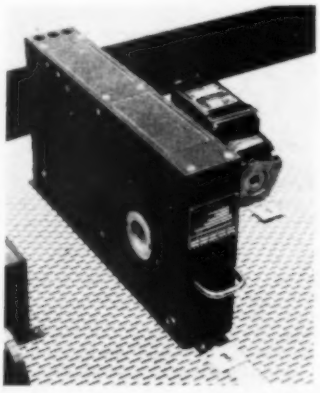
ROUND THE STATIC SHOW . . .

A model of a research-laboratory experiment indicated one approach which English Electric are making to the high-temperature insulation problem. This showed glass-insulated winding wires in a 400°C furnace withstanding 200V.

Plessey showed the 40kVA a.c. generating equipment which is being manufactured under licence from the Westinghouse Electric Company of America. This equipment comprises a brushless alternator designed on the rotating-rectifier principle, a magnetic-amplifier type of voltage regulator, and a control panel featuring transistor logic circuits carried on easily removable printed-circuit cards. Plessey have increased their range of electric actuators by introducing several types of both rotary and linear actuators for operation from 400c/s a.c. supplies.

English Electric (Aircraft Equipment Division) showed two new brushless alternators designed on the same principles as their earlier 40 and 50kVA machines, employing rotating rectifiers. One of these, rated at 55kVA indicated that this organisation has not confined its development activities to constant-frequency equipment. The other machine, rated at 30kVA and weighing 68lb was shown mounted on the new constant-speed drive already mentioned, suggesting that the company believe there to be an established requirement for equipment of this rating. The control unit associated with both the constant-frequency and variable-frequency alternators includes the magnetic-amplifier type of voltage regulator as well as the normal control and protection circuits. The construction uses printed-circuit techniques, but it was worth noting that connections to the individual printed-circuit cards were made by means of screws rather than pins and sockets.

Equipment for both d.c. and a.c. generating systems, as used on the Comet and Trident aircraft respectively, were shown on the **AEI** stand. Their a.c. system features a brushless alternator, rated at 22.5kVA, of the rotating-rectifier type. Machines for both systems are oil-lubricated, which is no doubt a further step towards the achievement of maximum overhaul-life periods. AEI have added several new items of switchgear to their already wide range. Included in these are hand-operated circuit breakers. Among the

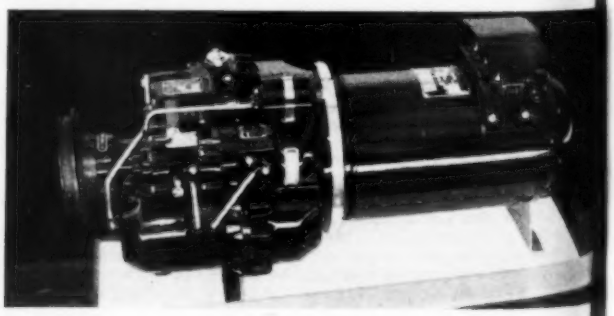


auxiliary equipment for engines, a new fully transistorized high-energy ignition unit was seen. The sealed-beam lamp recently introduced by AEI is finding application in new designs of landing lamp, including the **Harley** unit for the VC10.

Battery manufacturers have continued their efforts to reduce weight, examples of present units being a new **Dagenite** battery of 12V, 33A-hr capacity, and weighing only 28lb. **Venner** were showing examples of their silver-zinc and silver-cadmium batteries; these appear to be finding an increasing number of applications.

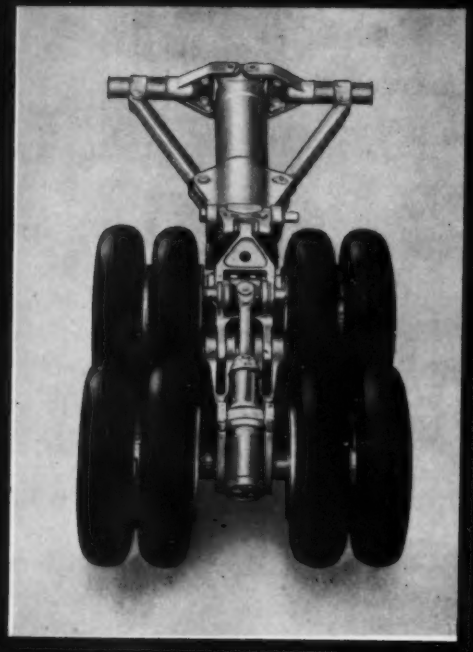
Many new switches were on view, and it was impressive to see the new Dowty Picaseal miniature sealed limit-switch operating under water. Plugs and sockets are still the subject of considerable development: at least one manufacturer has introduced a plug in which the pins are waisted, and individually self-locating. **BICC** point out that their EFGLAS cable is capable of operation at temperatures up to 240°C. **D. Napier** have introduced new ice-detecting equipment, and examples of applications of their Sierracote Plexiglas windscreens were shown.

Below, the Dowty-Rotol ram-air turbine unit for the VC10 (two are fitted), which weighs 23½lb and at the governed speed of 8,000 r.p.m. provides 15kVA plus hydraulic power. On the right is the new English Electric 30kVA Sundstrand drive and rotating-rectifier alternator



FIRSTS

in the design and manufacturing of undercarriage and hydraulic systems.



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by ELECTRO-HYDRAULICS LIMITED

FRANCE: SA Caravelle Breguet 1150 Atlantic Transall C160 Mirage 3
SWEDEN: SAAB Lansen SAAB Draken ITALY: Fiat G91T JAPAN: Namco YS11
HOLLAND: Fokker Friendship USA: Boeing 707 USSR: Rover APU

THROUGHOUT THE WORLD -

Major Continental aircraft and engine manufacturers choose Lucas fuel and combustion systems for their gas turbines and ram jet engines. In Great Britain too Lucas is in the forefront of the gas turbine equipment field. In fact the world over Lucas help to build and maintain the finest aircraft engines.

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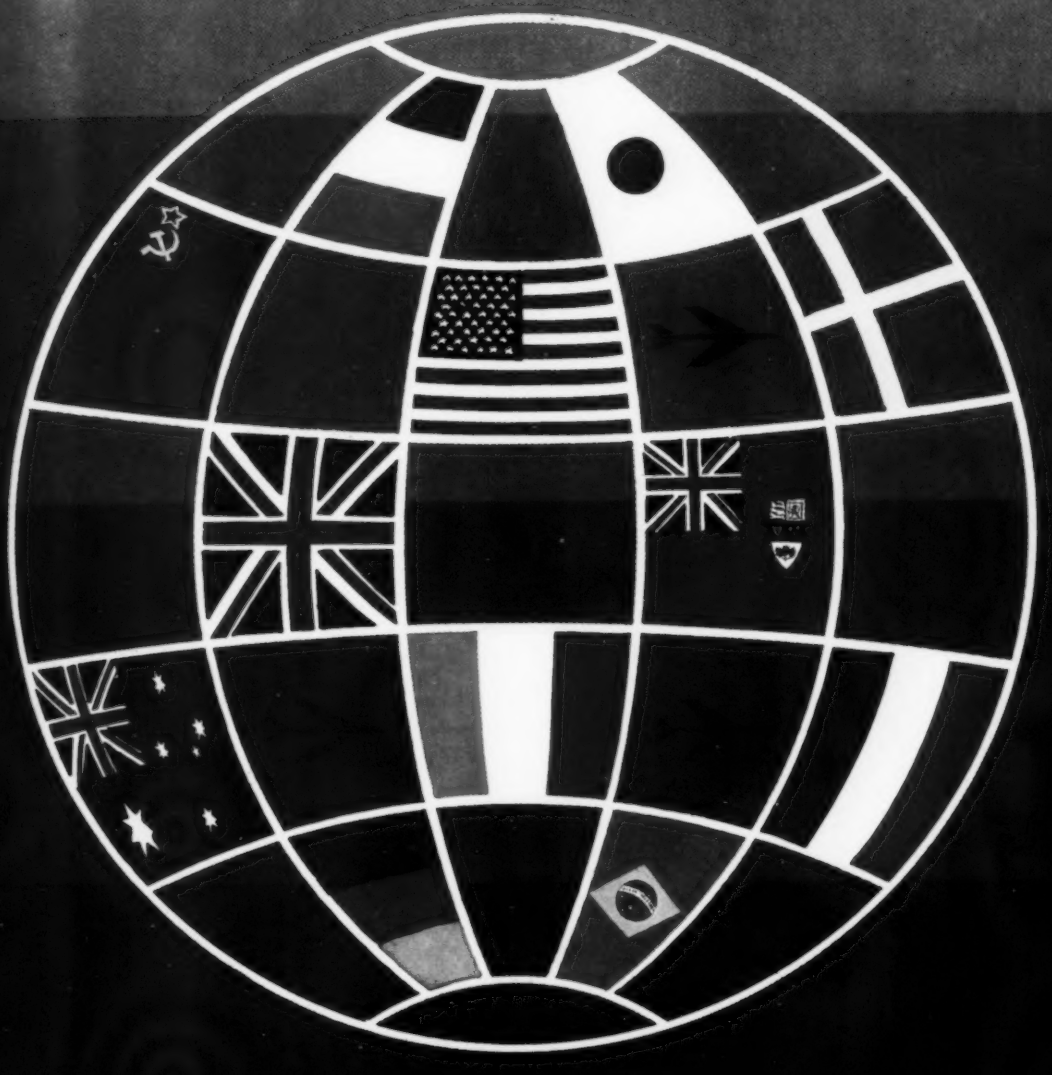

FRANCE: SA Caravelle Breguet 1150 Atlantic Transall C160
SWEDEN: SAAB Lansen SAAB Draken ITALY: Fiat G91T Macchi MB326
GERMANY: BMW engine type 6002 Dornier Do27 & Do28 JAPAN: Namco YS11
HOLLAND: Fokker Friendship USA: Grumman Gulfstream USSR: Rover APU

IN THE FINEST AIRCRAFT

Generating and starting systems designed, developed and manufactured by Rotax have for many years been fitted to the world's aircraft. The experience that is built into every piece of equipment Rotax produce make them Great Britain's largest exporters of aircraft electrical equipment.

ROTAX

Rotax Limited, Willesden Junction, London N.W.10.
Lucas-Rotax (Australia) Pty., Ltd., Melbourne and Sydney, Australia.
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Lucas, S.A.R.L., 11 Rue Lord Byron, Paris 8e.

We're flying the Atlantic . . . supersonic . . . in a flask

Not long ago the problem in jetliners was to prevent fuel from freezing. Shell research found the answer—the first low-freeze-point kerosine.

Now, with supersonic flight, the problem is heat. High temperatures in supersonic airframes, due to kinetic heating, affect the stability of conventional fuels.

In seeking an answer, Shell scientists simulate in a glass flask the atmospheric and temperature conditions which fuels would experience in supersonic flight. The effects are then measured by standard methods. Samples of metals used in aircraft fuel systems can be introduced to see how they influence the thermal stability of the fuel.

Research such as this is essential to the development of an economic fuel for supersonic flight.

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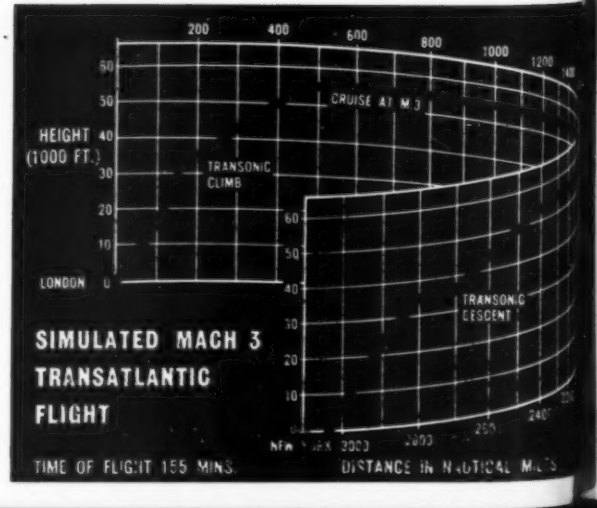
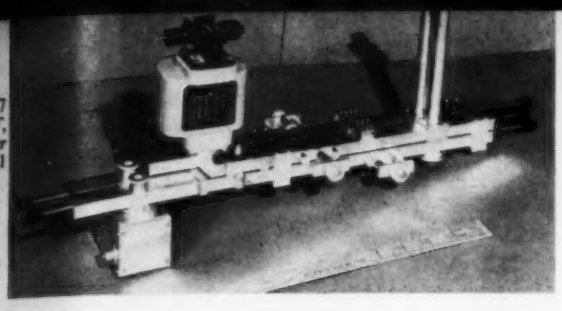
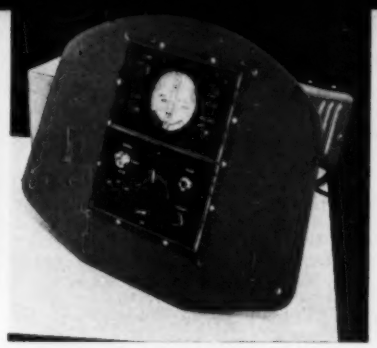
SHELL

AVIATION SERVICE







For left, the Marconi solid-state parametric amplifier and mixer. Above, the c.r.t. indicator and controller and the aerial for the Halpin ADAS combined MF/VOR receiver for light aircraft

ROUND THE STANDS . . .

Electronics

THE main trends this year were the extensive use of transistors, greater emphasis on component reliability and the increasing use of computers in navigation and air traffic control equipment. One result of transistorization has been to reduce some of the more sophisticated equipment to a weight and size suitable for light and executive aircraft. Therefore, while nothing sensational emerged at this year's show, the aircraft industry and operators will welcome the increased reliability, reduced weight and power consumption which the past year's developments have introduced. Increased use of digital techniques combined with transistors open up the prospects for microminiaturization in the near future.

Marconi's Wireless Telegraph Co showed their new "Sixty Series" of airborne communication and navigation equipment in which the emphasis is on reliability coupled with the use of transistors. The receivers of this series are fully transistorized as are transmitters except for driver and output stages. Sealed modular construction is used and each module is filled with dry inert gas. The VHF portion of the "Sixty Series," the AD.160, has now completed its tropical trials. Marconi expect to be in production early in 1962 in time for the VC10 and Tridents for BOAC and BEA. It is interesting to note that the "Sixty Series" cases conform to ARINC characteristics and are interchangeable with compatible American units.

Marconi announced that orders for their Doppler navigator AD.2300B now exceed the £4m mark.

Another item of interest was the new solid-state parametric amplifier and mixer. Experiments with this device in a Marconi SR.1000 radar transmitter/receiver (aerial temperature 120°K) have shown it to improve the overall noise factor from approximately 7 to 2.5 db, equivalent to an increase in transmitter power from 500kW to 1.75MW. This particular amplifier has been designed to accept 600 Mc/s. An interesting PPI visual demonstration showing the gain in range due to this device was available on the stand. Industrial as well as aeronautical uses of the 1016 tabular display were shown.

Of particular interest to light aircraft owners was the transistorized ADAS (Aircraft Directional Accuracy System) shown by **Halpins of Hampshire Ltd.** The equipment has been developed, flight-tested and is now in production after being approved by MoA. Class 1 approval has also been applied for. ADAS may be used for taking bearings to MF beacons and ranges or VOR beacons. An ILS letdown can be carried out using the localizer, passage over the markers being indicated on the main 2½in c.r.t. without a separate 75Mc/s marker beacon receiver. The system comprises an MF receiver, a VOR/ILS receiver and a c.r.t. indicator with controls. It is claimed to be the first system in which a combined indicator is used to display both VHF and MF signals.

Signal-to-noise ratio is stated to be 6db for 1 micro-Volt input. Another feature is the combined MF and VOR aerial, which requires only a one inch hole in the fuselage. Total installation time for the system is ten hours.

R. B. Pullin showed for the first time their airborne dipping asdic equipment used as part of the weapon system of the Westland Wessex. The equipment consists essentially of an electro-acoustic transducer which can be remotely raised or lowered by a cable hoist and rotated electronically on to any desired azimuth. Information on the depth of the dome and height of the helicopter above water are also provided.

Among other items the **Solartron Electronic Group** showed their fully transistorized radar simulator for air traffic control training. The standard model provides for up to six targets and a playing area of 50 or 200 miles. The simulator is based on modern analogue techniques using special types of transistorized circuitry, and is available for use within one minute of applying power. The equipment is so designed that after the initial installation the use of the simulator can be extended either by increasing the number of targets or by adding an additional simulated radar, to look at the same targets, such as precision approach radar or height-finding radar. Each target control unit enables the operator to simulate aircraft at speeds up to 1,000kt and heights up to 50,000ft. The equipment itself has been engineered to employ a comparatively small number of versatile printed-circuit, plug-in, transistorized sub-units, each of which can perform any one of several functions, according to which part of the simulator it is serving. Modular design of this type gives the system great flexibility and allows it to be varied and extended to cover almost any requirement. Perhaps the greatest appeal will be its small size, weight and power consumption. The control unit measures 16in × 21in × 14in and weighs 70lb; and the pedestal measures 28in × 21in × 31in and weighs 250lb. Total power consumption, excluding the display unit, is 0.5kW for six targets.

With an eye to the forthcoming Ministry of Aviation instruction making it mandatory to carry secondary surveillance radar in civil aircraft operating above 25,000ft over this country **Cossor Radar and Electronics Ltd** exhibited their civil transponder SR.1251, which now has Ministry of Aviation approval. The airborne equipment is 60 per cent transistorized. The present transponder is equipped with two-pulse side-lobe suppression, but later models will be able to operate on either two- or three-pulse systems. Two-pulse equipment will be capable of modification to three-pulse working. Provision is made in the transponder for the incorporation of further facilities, in particular those associated with dual transponder operation and with the provision of automatic selective reply and PAR facilities. The SR.1251 can also be modified to accept a digital input for automatic altitude data transmission. The weight of the complete airborne installation is about 33lb.

On the same stand, Cossor showed their quartz delay line ultrasonic devices for the storage of pulse information over periods of 3 to 2,500 microseconds. They are being used to give an apparent improvement in the threshold of radar receivers and permitting, in certain applications, radar tracking to extreme ranges under fading conditions.

Standard Telephones and Cables Ltd showed the new STR.37 fully transistorized low-power transmitter/receiver, which is designed for use in light aircraft and has a power output in excess of 200mW. Compact amplifiers are available to increase the output to 6 or 25W. The STR.37 provides 400 switched channels in the range 116.0 to 135.95Mc/s. Power consumption on 28VDC is approximately 2W while receiving and 4W while transmitting. The equipment weighs only 6.5lb. There is a matching independent radio navigation system comprising the ILS/VOR receiver, instrument drive unit and marker receiver.

S.T.C. also exhibited their new long base-line direction finder using a true Doppler technique. Its design departs from current long base-line direction-finder practice in that it uses a rapidly rotating aerial system giving a true Doppler effect as opposed to the simulated Doppler effect used in most other long base-line systems.

New techniques have enabled S.T.C. to produce a system which overcomes the earlier difficulties of rotating-aerial Doppler systems and avoids the high cost of fixed aerials with high speed commutation to simulate the Doppler effect, but still falls within the maintenance capabilities and price range of the world's smaller airports. The aerial site equipment for S.T.C.'s new Doppler direction finder consists of a resin-bonded glass-fibre radome containing two VHF dipole aerials on a 12ft cross-arm which rotates at 180 r.p.m. A cast iron weather-proof cabinet on the ground contains the radio receiving equipment. The only other apparatus in the system is the remote bearing indicator and its driving unit, normally installed in the control tower. The aerial site equipment is 22ft high and 14ft in diameter. The bearing indicator is a new and very accurate (0.5°) electromechanical device having a dead-beat action and a response time of only one second.

Ekco Electronics have now extended the scope of their airborne weather radar E.190 by the development of additional and alternative units. The introduction of a smaller and lighter scanner reduces the weight of the total installation from 60lb to 46lb and makes the equipment suitable for executive-type aircraft. The E.190 range now consists of standard transmitter/receivers and standard indicators. These units can be coupled to three types of scanner, the lightweight scanner M.2267 weighing only 8lb, the M.2210 scanner weighing 26½lb and the M.2269 weighing 27lb.

For larger aircraft where essential services are normally duplicated,

ROUND THE STANDS . . .

it is now possible to extend this facility to the weather radar by using twin standard E.190 indicator and transmitter/receivers and scanner M.2269. This is a modified version of the M.2210 scanner in which the electronic components of the stabilization servo-amplifier are duplicated and mounted in a separate junction box M.2233. Duplicate synchros are fitted to operate the twin indicators.

Further emphasis on reliability is given by **Decca Radar** who claim a system availability of over 99.8 per cent with the prototype of a new and complex radar display system, a performance which has been sustained over the whole period of the prototype trials, which already exceeds 10,000hr. This advance in reliability for such systems has been made possible by a breakthrough in the engineering of transistor circuits. Decca engineers have developed a new technique based on environment stabilization whereby all circuits and transistors are maintained at a constant internal temperature to within ¼°C and at controlled humidity. Liquid cooling provided by an integral refrigeration unit and heat exchanger is combined with a mechanical design in which excellent thermal insulation is achieved. Ambient temperature variations between 0°C and 45°C, with relative humidity ranging from 10 per cent to 90 per cent have been successfully handled. During the 10,000hr trials mains voltage varied by ±15 per cent, but stability was such that display error was consistently less than 0.2 per cent overall and less than 0.08 per cent for short-term measurements.

This new engineering concept makes possible the reliable employment of transistors in electronic equipment where very high standards of performance and circuit stability are required. In the engineering of typical data handling and display systems for civil and military operations rooms, and in naval vessels, it provides a reduction in power consumption by a factor of approximately eight. Of even greater importance is the very high reliability with minimum servicing attention which can now be achieved, even where great complexity and elaboration must be introduced to meet exacting operational requirements.

Following successful operation of their prototype equipment, Decca have developed production equipment and are now completing units for early delivery in a military project.

Two new Decca meteorological radars are also on show. The Type 43 is a sophisticated 3cm radar with a narrow vertical beamwidth designed to display vertical structure as well as giving a PPI presentation of precipitation echoes. The Type 44 is a 750kW, 10cm weather radar specially designed for the detection of precipitation at long ranges under all conditions, and particularly for the penetration of cyclones and heavy rain areas.

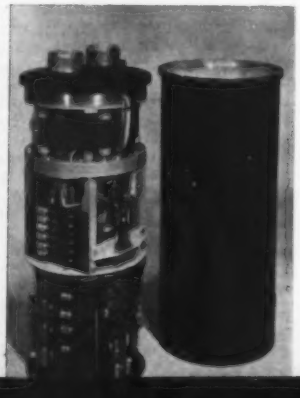
A recent development by the **General Electric Co** is a digital data transmission system for air traffic control applications, consisting of a ground-to-ground digital data link and an airborne digital-to-analogue converter unit.

Of particular interest in the ground link is the use of three standard land lines to achieve high information rates of up to 3,600 bauds.

The equipment as designed and built uses three such telephone circuits in parallel, each being fed by 18 message channels (50 baud) of standard G.E.C. Telephone Works VFT equipment. For each circuit the VFT equipment comprises a 20 channel assembly on a standard 7ft 6in rack, one channel being used for a start signal and one as a standby spare, in addition to the 18 information channels. Thus the message rate for the three circuit system as built is 2,850 bauds, but various modifications can readily be incorporated to meet other message rates. For example, a single VFT circuit can be used where a signal frequency of 900 to 1,000 bauds suffices. Alternatively simple extensions of the design would permit the use of 24 channel VFT equipments on a 9ft rack with a correspondingly higher rate of 3,600 bauds. Even higher transmission rates are possible by increasing the bit rate in the individual channels.

After conversion in the airborne data link unit from digital to analogue form the instructions to the aircraft can either be displayed on suitable instruments or coupled into the autopilot. Both ground and airborne units are fully transistorized and are designed for high reliability.

Below left, the airborne unit for the G.E.C. data link and, right, the Ferranti audio warning system with tape unit at the top



Redifon are showing their aircraft accident data recorder which records on magnetic tape, and via transducers, important information for post-flight analysis. Two versions are available. One provides a long duration record and the other, using a continuous loop, provides a progressive 15min record. The latter version is housed in an ejectable container which incorporates the necessary radio aids to recovery on land or sea. Also shown is the Redifax, a facsimile equipment suitable for weather map transmission and reception. Other items shown include a VHF 1kW ground transmitter for ground/air long-range VHF communication and the latest RADIC analogue digital computer which is intended for educational research applications and provides visual demonstrations of solutions both on a c.r.t. and on a co-ordinate plotter.

The new PA.230 1kW HF linear transmitting amplifier designed for aeronautical, marine and civil administration services is the most recent addition to the **Plessey** range of telecommunications equipment. The most advanced electronic techniques have been employed in its design and in general it meets the requirements of D.E.F. 5,000 and I.S.C.T.C. specifications. A special feature is the use of silicon rectifiers in all units.

The amplifier comprises an RF unit, power unit and control unit. Provision is made for incorporating a drive or converter unit. The amplifier is continuously tunable over the frequency range 1.6Mc/s-27Mc/s and is capable of delivering a power output of 1kW (p.e.p.) into a 50 Ohm unbalanced line. Under continuous single-tone operation 1kW mean power is available.

The bandwidth of 12kc/s permits the operation of ON/OFF keying (A1) double side-band full carrier (A3), single side-band (A3A), independent side-band (A3B), frequency shift keying (F1) and four frequency diplex telegraphy (F6).

Comprehensive monitoring facilities are provided, including forward and reverse power monitors, which indicate the amplifier output power and allow the standing wave ratio on the output feeder to be determined. At present the equipment can be remotely controlled over land-lines on six preset frequencies. A multi-tone RC unit will shortly be available.

A new equipment, on display for the first time, is the **British Communications Corporation** VHF packset Type 40, which is stated to be the smallest and lightest of its class in the world. It is a fully transistorized set for single- or double-frequency simplex operation in the VHF bands. It contains a transmitter, high-grade single superhet receiver with crystal filter, re-chargeable battery and loudspeaker. Either a hand telephone or fist microphone may be used with press-to-talk facility. The frequency range of 30-174Mc/s is covered in four bands, a different version of the set being required for each band. Four preset channels are available and can be used for single or double frequency simplex operation. The transmitter has an output of 150mW. Power is obtained from a rechargeable DEAC 13V battery with a capacity of 450mW. A telescopic aerial forms an integral part of the equipment. This little man-pack measures 5in × 2¼in × 7¾in and weighs 2¼lb with its battery.

As an advance on the present method of drawing the pilot's attention to system faults by flashing lights or illuminated labels, **Ferranti** has introduced a transistorized audio warning device which can provide immediate speech warning in the pilot's headset of faults monitored by the central warning system in the aircraft. This effectively reduces the pilot's visual work load.

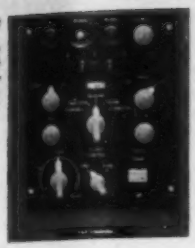
The transistorized audio warning unit comprises a tape transport mechanism and selector switch driven by a governed d.c. motor with gear head. The selector switch continuously samples the input signalling wires so as to automatically connect the appropriate track to a playback amplifier. The bandwidth of each audio channel is 300c/s to 2.5kc/s.

Warning messages are recorded on a closed loop of magnetic tape 9in long and 1in wide and having 16 tracks, one for controlling the indexing of the tape and the remainder for messages. The message length can be of up to 3sec duration, although this can be extended if necessary. Priority messages can be given precedence and are repeated continuously until manually cancelled by the pilot.

The prototype audio warning unit is housed in a hermetically sealed cylindrical container 10in long and of 4½in diameter filled with inert gas as a protection against severe environmental conditions. Weight of the unit shown is 6lb, but length and weight of the production version will be halved.

General Precision Systems announce that a substantial contract has been placed by the Ministry of Aviation for their visual flight simulator attachment for addition to all types of flight simulators in service with the RAF. Known as Terravision, the attachment may be added to all makes and types of existing or planned flight simulators and presents a dynamic picture of an airfield during take-off and landing. It provides the pilot, whether he be of a high order of proficiency or a student, with all the visual cues which hitherto have not been available to him.

The Ministry of Aviation carried out an extensive evaluation before agreeing the technicalities of the specification for this contract, which is the first of its kind to be placed in Europe.



Above, the entirely new pilot's controller for the Smiths SEP.4B autopilot; above right, the controller for the Universal Autopilot made by Sperry Pheonix and exhibited at Farnborough for the first time; right, the Sperry SP-3 autopilot for business aircraft, showing the pilot's controller and the 3-axes computer actuators (from one of which the cover is removed)

ROUND THE STANDS...

Flight Control Systems

"ONE cannot produce a new autopilot every year," said Mr A. M. A. Majendie of Smiths, and this can be taken as a fair first view of the autopilot constructors at the Show. There is little really new at first sight, but from discussions with Elliotts, Newmark, Smiths and Sperry there came clear evidence of good, sound progress over an enormous range of automatic flight control equipment. British autopilot constructors are taking wide advantage of American eagerness to get into European and Commonwealth markets by establishing new licensing agreements, particularly in connection with light-weight autopilots, about which there was much to say at the Show. The advent of these autopilots also marks the beginning of a division between those autopilots intended as light-weight, adaptable, general purpose systems for executive and training aircraft and the sophisticated systems of the VC10 and de Havilland Trident generation which show distinct developments towards a state where aircraft will become tailored to an operational requirement which is postulated by a centralized and automatic flight management system.

Sperry had the SP-3 light-weight autopilot on display and Mr J. S. King, their assistant sales manager, described the "building-block" principle of its construction. Either single, double, or triple flight axes control can be installed as required by an individual customer. The system was developed by Sperry Phoenix in the USA and has been designated for the Beagle 206 and the Short SC.7 Skyvan. The SP-3 on show consisted of the summation of the individual SP-1, 1A, 2 and 2A facilities which are the designations of each "building block." SP-1 consists of a solid-state power adapter with voltage regulating circuits, a pilot's on-off switch, panel-mounted directional gyro for yaw stabilization and the rudder computer actuator. The SP-1A offers stabilization by ailerons as opposed to the rudder stabilization of the SP-1 and includes automatic heading hold. Advancing through the range the SP-2 gives pitch and roll stabilization by aileron and elevator, the 2A has the addition of automatic heading hold, whilst the SP-3 is the full three axes autopilot. Coupled ILS is being developed as a facility to be offered shortly. The total weight of the SP-3 system is quoted as 27.5lb and is offered at under £2,000.

Sperry had a "Universal Autopilot" on show, also of US design, which arose from a US Army requirement for an autopilot which would control all their vehicles; helicopters, drones, fixed wing aircraft and tanks. The build-up system gives the facilities required in each vehicle up to and including 5 axes helicopter control. The neat pilot's controller of this autopilot which was on show, with its concise, positive action, is a pleasure to operate.

The Sperry magnetic storage drum on show has been developed from work on GPO subscriber trunk dialling and offers a range of compact, high-speed, digital stores. The rotor diameter is only 3in but can provide up to 68 tracks. Sperry offer to undertake to manufacture drum units to customer requirements complete with permanent waveforms written on the drum. One application offered is the storage of flight plan information, although the D2 has been used in the experimental Decca Omnitrack.

Near at hand the **Newmark** stand had a number of interesting developments on display. The company has now had 3 years' service experience on its Sea Vixen autopilot but the new packaging techniques described by Mr Don King, Newmark development engineer, were a most interesting feature. The modules allow tight packaging of delicate components and the transistor cards form the sealed faces of the cells of the modules. They will form the basic units of the transistorized autopilot which Newmark aim to have in production within the next two years for a British helicopter.

Newmark also had on show a sub-miniature rate gyro. This is based on a Lear design and will be in production in this country next year. It is regarded as an essential requirement in the process of microminiaturization but, to combat the problems of providing a rugged design, it was tested in the unit on show by providing a relatively heavy frame to support the gimbal. The microsyn pick off converts the angular displacement of the gimbal into the electrical signal which is linear to the gimbal displacement. The unit only requires 20sec run-up time and is already offered with a minimum of 1,000hr between overhauls.

Smiths Aviation Division had an impressive display of their progress on the SEP.4, SEP.5 autopilots and the work on the para-visual director. The SEP.4B pilot's controller was on show for the first time, part of a system which offers single-channel Autoland. Prototype equipment is to be fitted to the Transall AT.160 aircraft of the German Air Force and evaluation is to be carried out on Noratlas and Argosy transports. Production is scheduled for 1962. The particular feature of this autopilot is that no command can be put into the autopilot without appearing on the flight system display. A radio switching unit can be designated as part of the system if required by the operator. This box handles all the radio switching in the aircraft from VOR, ILS, etc, and the packaging has been achieved by substantial use of Smiths micro relay.

The SEP.5 designated for the Trident and the Belfast has been on show now for two years but substantial development is being carried out under the auspices of Smiths and the MoA on a Comet 2E. Some 150hr of high speed, approach and radio-coupling flying have now been completed on this aircraft's prototype multiplex equipment.

Mr Kenneth Dowell, Smiths autopilot sales engineer, described the advances made in the PVD evaluation since last year. Trial installations have been made on a KLM DC-8 and the Boeing Company are "actively interested." BEA are using the PVD in a Whirlwind helicopter for collective pitch information, whilst BOAC are to take delivery of a trial installation for a Boeing 707.

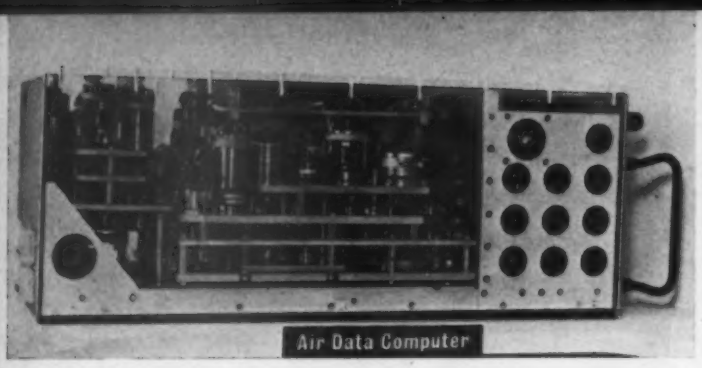
The Smiths air data computer on show for the Trident was the latest of nine different versions so far made in the course of ADC development. All are centred round the force-balance unit and the variations between each primarily concern the numbers and types of outputs required by manufacturers of ancillary equipment. One of the range is being considered for a NATO supersonic bomber but further details could not be disclosed.

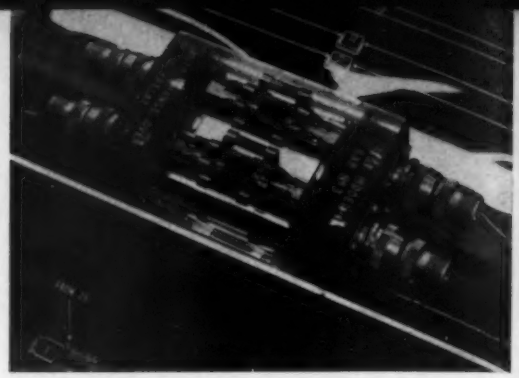
Smiths are also in the light-weight autopilot field and Mr Frank King described the plans to make the Motorola M.4 under licence in the UK. This he considered an ideal autopilot for the growing executive aircraft market, in particular for the Beagle range. The autopilot can offer three axes control, plus manœuvre control, height lock, VOR and ILS coupling and the pleasant addition of yaw damping.

Turning to **Elliotts** the theme of their display was "Automation from Take-off to Touch-down." The equipment on display in both civil and military fields offered fully automatic flying and indeed the range of automated facilities offered to aviation covered everything from seat reservations to automatic landing.

The divisional manager of Elliotts Transport Aircraft Control Division, Mr Ron Howard, described the completion of the development of the VC10 monitored duplicate system, which is basically designed to provide fault-survival capability. This is considered by Elliotts to provide the best practical solution to maintaining multiple autopilot systems in a satisfactory service state.

Elliotts had on display the auto-changeover relay which performs the function of reliably switching out a failed system and engaging the second autopilot system instantaneously and without flight path disturbance. The unit is in fact a highly reliable relay with the sections associated with the two autopilots stringently separated. The relay contacts are magnetically operated and sealed





Left, the first illustration of the centralized air-data computer developed by Smiths Aviation Division for the de Havilland Trident. On the right is a close-up of the Elliott Brothers (London) auto-change unit for the duplicated autopilot systems of the VC10; this unit is encased in a transparent resin

ROUND THE STANDS...

individually in glass tubes containing dry nitrogen. The striking feature of the assembly is that it is completely sealed in a transparent resin and so can be fully inspected without the need to dismantle the unit.

The VC10 autopilot dual controller on show had obviously had the pleasing design attention of a modern industrial designer. The unit provides the facility for the engagement of both monitored autopilots at the same time, or independently, depending on crew choice. The autopilots are scheduled to be mutually exclusive in cruise but selection of the automatic landing sequence will bring both autopilots into play. The controller consists of three manometric lock facilities; Mach, IAS, and Height, plus post-engagement pitch datum adjustment.

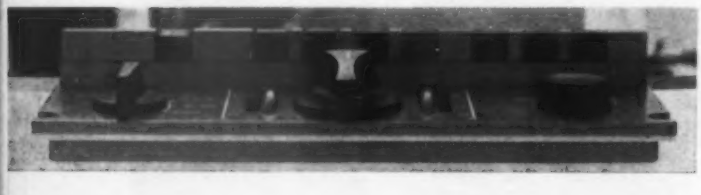
On the military aircraft side Elliotts had on display the pilot's controller for the Lightning Mk2, part of a flight control system now in full production, and a display of automatic throttle control which it is understood has already been designated for the Sea Vixen. Elliotts are still the only company in Western Europe designing and producing in quantity autopilots for supersonic aircraft.

During a discussion Bill Alexander and Peter Hearne, two of the Elliott Guided Flight Group assistant general managers, postulated Elliotts' forward thoughts on flight control. They stated that the Verdan computer on show is indicative of the future integration of flight control and navigational systems into a centralized digital flight-management system. Elliotts are placing great stress on the development of reliable components and microminiaturization and to this latter end have announced the establishment of a Micro-Electronics Laboratory to promote these concepts. Mr Alexander said that he believed we were entering the era when automatics are becoming the essential parts of the aerodynamic design of new aircraft and that electrical signalling will rapidly replace mechanical control runs. In order to provide the high orders of reliability required Elliotts are promoting integrated redundancy in each unit of a system, whilst of the future systems themselves they believe that in self-adaptive autopilots short term stability augmentation will still be analogue in form, whereas control of autopilot gearing and other long term parameters will be digital.

The overall impression of the displays on automatic flight control is one of positive, mature progress in probably the fastest-growing field of aviation development today. However, *Flight's* correspondent was able to contribute himself to this progress by revealing to one, otherwise innocent, company that it made autopilots—according to the catalogue!

Boulton Paul Aircraft announced at the show that they had designed and manufactured the powered flying controls for the Bristol 188, the design being evolved in association with Bristol Aircraft Ltd. On the Short Belfast Mr J. R. Padget of BPA also stated that they are responsible for the design and manufacture of the "packaged" controls for the spoiler surfaces. These units will have all-electric signalling and the "packaging" consists in fact of a safety concept in that each unit is independent of the others and therefore failure of one does not adversely affect the overall operation of the spoiler system.

An edge-on view of the excellently styled pilots' controller for the Elliott Brothers autopilot system of the VC10. Behind the three manoeuvre and selector knobs may be seen the manometric lock switches for height, Mach and similar parameters



Dowty-Rotol had one of the most outstanding displays of the show in terms of the new equipment appearing for the first time. Mr T. J. Head, Servo Group manager, described these new advances, probably the most interesting of which is an engine rotation jack. This unit has been specified for a new VTOL development in Germany and gives 100° of rotation to the engine. This arc of rotation will in fact be used to provide auto-stability to the aircraft in the VTOL phase of flight. It is a mechanical input servo actuator incorporating hydraulic system duplication, a stabilizing device on the mechanically controlled spool valves is operated by actuator differential pressures and adjustment of the device permits the loop gain to be modified for optimum performance. The dry weight of the unit is 40lb and it operates on a hydraulic-system pressure of 3,000lb/sq in.

Also on show for the first time was a control surface actuator operated by manual input. It contains hydraulic and mechanical locks for safety and two built-in pressure relief valves to safeguard the unit in event of an automatic cut-out failure. It operates at 4,000 lb/sq in, and has been selected for a new Indian aircraft project—doubtless the HF-24—to facilitate the use of the all-moving tailplane and elevators. Adjustable gain control can be set on the unit to cover a particular aircraft's characteristics.

A servo actuator on display is destined for the same German aircraft as the engine rotation jack. It is an electrically signalled hydraulic unit suitable for differentially applying mechanical input signals to a powered control system. It can be used to inject a flutter cycle in flight and the incorporation of a Moog valve in the mechanical feed-back circuit obviates the need for a weighty feedback amplifier and pick-off. Its dry weight is 6lb and it operates at 3,000 lb/sq in.

The last two units of particular interest this year on Dowty's stand were a control surface actuator where the actuators could either be part of or separated from the unit's control box. Loop gain can be adjusted for optimum performance and the actuators also contain the earlier safety devices described for the other units. The authority of the electrical mode of operation is manually controlled via solenoid selector valves. The units are designated for a number of classified aircraft projects and should, because of their light weight, 19.3lb in combined dry form, and small size, be extremely valuable contributions to an aircraft designer's fight against weight and space.

The Hydraulics Division of **Fairey Engineering** had on show a model of a safety system now in full production for the Westland Belvedere to cut out the effect of a seized hydraulic valve. The Belvedere has two hydraulic systems and so cannot overcome a faulty valve by isolating it as in the triple system used in the Trident. The system was described and demonstrated by Mr Frank Mattos, chief designer of the Hydraulics Division. It consists of the use of hydraulic system pressure to release the pilot's input linkage from the seized valve. This is done by lifting a poppet valve at a preselected breakout load well within the pilot's stick force capacity. The lifting of the poppet results in an overbalanced hydraulic condition which "fires" the poppet out and which introduces a backlash within which the good system can be operated. In operation the system proved smooth and immediate in reaction to the failure with a hardly noticeable increase in stick force to breakout.

Hobson are actively engaged on the design studies for the BAC One-Eleven and Mr P. J. Maltby, Hobsons systems engineer, stated that these designs covered flap control gear, tailplane trimjacks for the all-moving tail and artificial q-feel. Recirculating ball screw jacks are proposed for the flaps and tail of the type shown, and which first appeared last year.

It is clear that the manufacturers of powered flying controls at this year's show are in line with electronic designers seeking new ways to produce smaller power-packages. Built-in system redundancy is becoming more and more the accepted fact.

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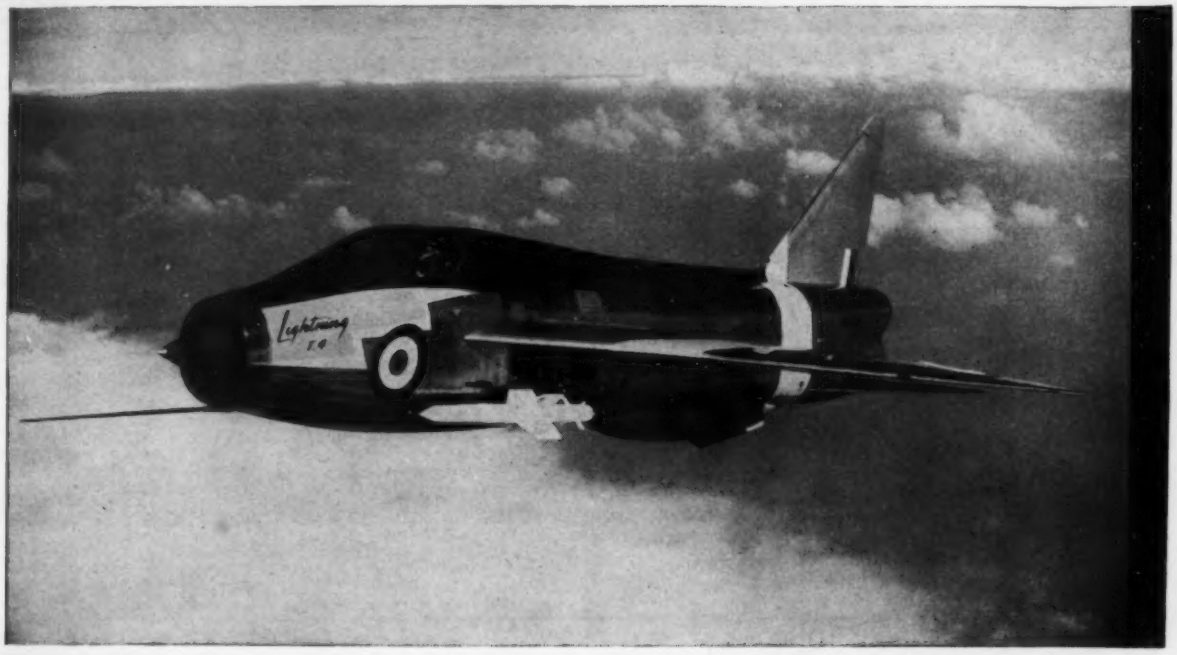
VANDERVELL
BUSHES

Vickers Vanguard
(above) Vandervell Bushes are fitted to flap mechanisms.

English Electric Lightning Supersonic Aircraft
(right) Vandervell Bushes are installed in actuating mechanisms for power assisted controls operating ailerons and tail plane.

Armstrong Whitworth Argosy Type AW 650 Freight-Liner
(below) Vandervell Bushes are fitted to pivot points on control mechanisms.

used in the aircraft industry



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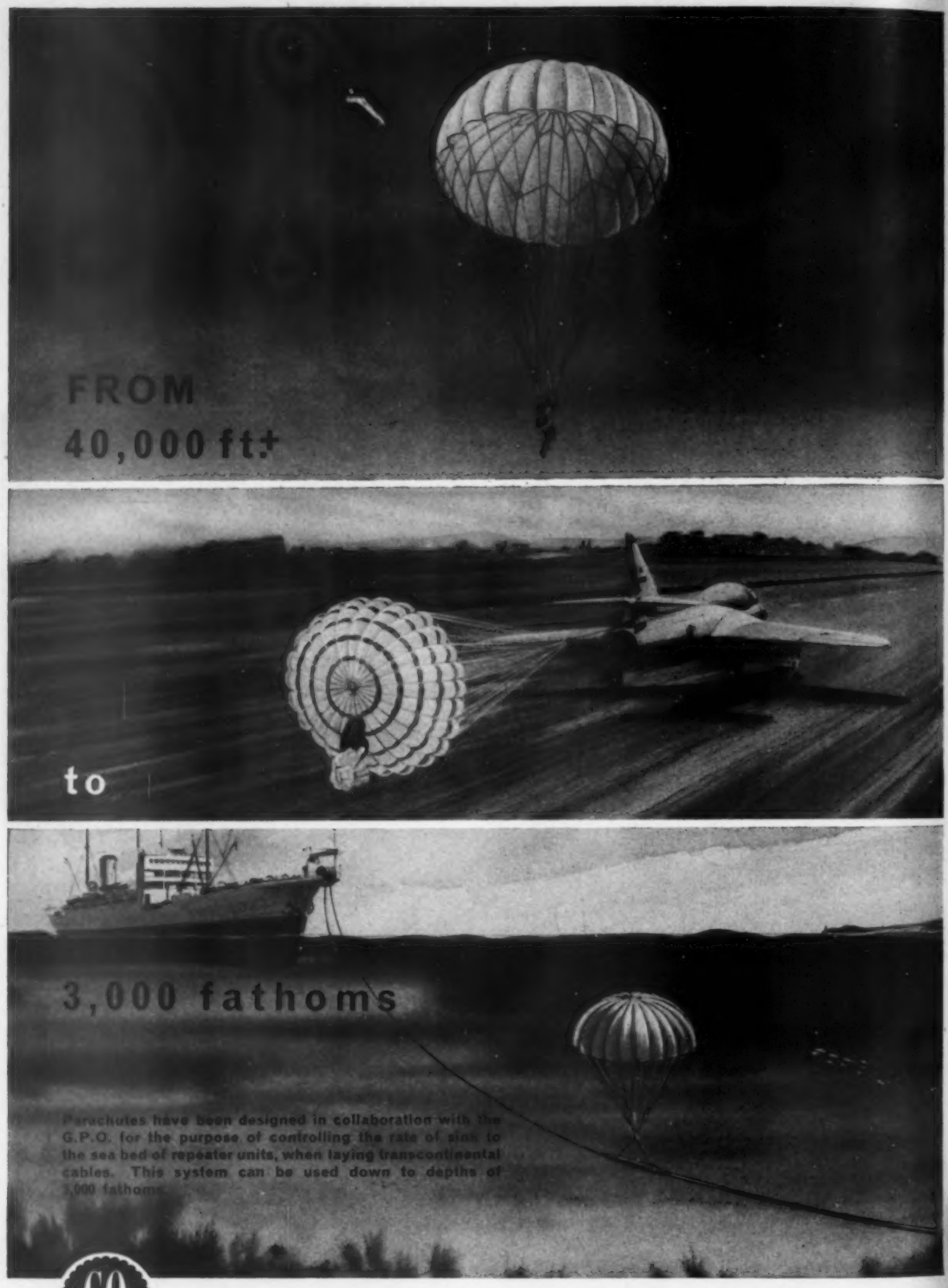
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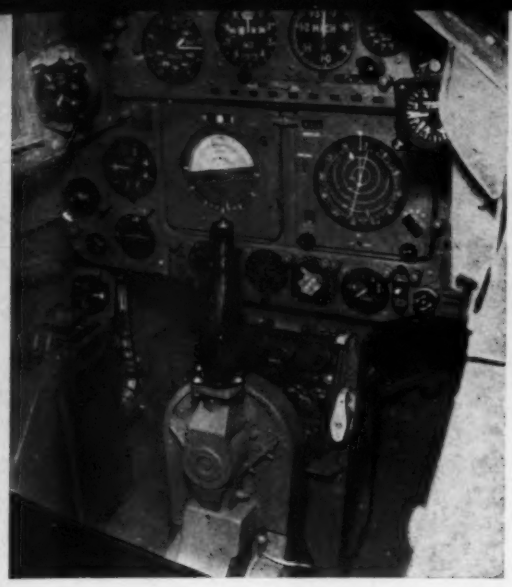


Above, Ferranti Type 100 inertial platform with two Honeywell and one Kearfott floated gyros. Weight is 80lb and run-up time 45min

Left, simplified OR.946 roller-blind instrumentation in the Gnat trainer. The navigation display on the right is in the Tacan mode

ROUND THE STANDS . . .

Flight Instruments

There was relatively little new in the way of flight instruments to be seen in the static display this year, although some new information was available concerning the principal lines of development.

Smiths Aviation Division were able to report solid progress with PVD during the past year. KLM are now evaluating the system in one of their DC-8s with the dual considerations of retro-fitting their existing fleet, or a part of it, and specifying PVD for their future aircraft. At first, some difficulty was experienced in "optimizing the parameters," but after a change of gearing the standard length of PVD indicator proved effective. KLM have now also asked for the flare-out director function to be added to their PVD and the necessary computers are to be delivered by Smiths next spring. Boeing are preparing to begin PVD evaluation flying in the 707 "dash 80" prototype very soon and US airlines are closely watching progress. Sud Aviation are to receive a PVD for a Caravelle this month. The RAF has begun a formal evaluation. BEA has for some time successfully used PVD indicators as vertical directors in their experimental Whirlwind helicopter.

MoA and **Rank Cintel** both exhibited the Peep system of flight director and attitude symbols projected onto a gunsight reflector from a bright, miniature c.r.t. Development continues and early trials in an RAE Meteor are now to be followed by tests in Hawker's demonstration Hunter 66A, G-APUX, which will be re-designated Mk 12 for the occasion. It is also announced that the Belfast will have Peep instrumentation as an addition to its Smiths Triplex automatic landing system.

An extension of the use of small c.r.t. displays in the cockpit is the new central warning system based on a tri-colour c.r.t. on which any of a large series of warnings can be written in one of only three spaces, and in three colours denoting the degree of urgency. Normally, a separate sign has to be provided for each warning and some 20 or 30 may have to be accommodated on the instrument panel. The c.r.t. is 4in square and 10in deep and the related circuitry is transistorized. A storage facility also allows a warning not requiring immediate attention to be cancelled and re-shown at specific time intervals until the condition has been rectified. The system shown at Farnborough is proposed for a helicopter.

Incidentally, Rank Cintel also exhibited the Vigil vertical gyro indicating instruments which they are to make under licence from Guidance Technology Inc in the US. The instruments can be of 2in, 3in or 5in diameter, contain integral lighting and require no outside service, other than a source of power.

The RAF's latest OR.946 roller-blind instrumentation, now being installed in an increasing number of Service aircraft, was to be seen in a simplified form, without tape indication of i.a.s. and Mach number, in the Gnat trainer. Among possible settings of the navigation display was one for data link by which flight commands can be fed from the ground by data link directly into the flight instruments. This would have obvious applications in intercepters.

Ferranti showed their new Type 100 inertial navigation system, a medium-sized unit containing its own electronics and based on one licence-produced Kearfott floated integrating gyro and two English Electric-Honeywell GG.49D miniature floated gyros. Weight is 80lb and spin-up time 45 min,

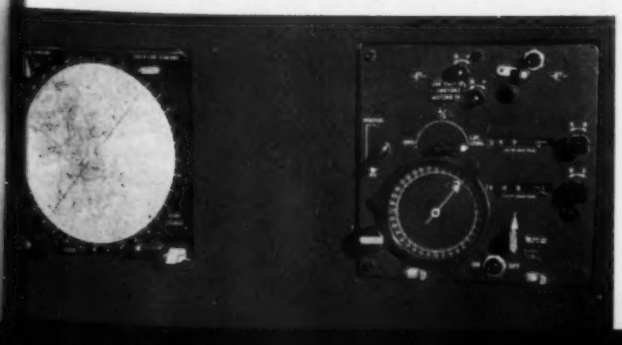
Ferranti are "productionizing" the MoA moving-map display. The topographical map is back-projected from 35mm film 10ft of which will contain sufficient frames to cover all Europe. Frames are changed automatically when flying north or south, but manually east and west. The pilot carries a card giving a key to frame numbers. Rotation of the map for track stabilization is by swivelling a prism in the optical system without disturbing the main positioning machinery. MoA have used moving map with **GEC's** Dexan digital navigator and Doppler.

Superimposed on the coloured map picture are track cursor and desired heading and distance line, together with a present-position circle and compass bezel. The whole unit weighs 15lb and measures 14in × 7¼in × 16¼in deep. It seems likely to be adopted for advanced military aircraft with complex navigation systems.

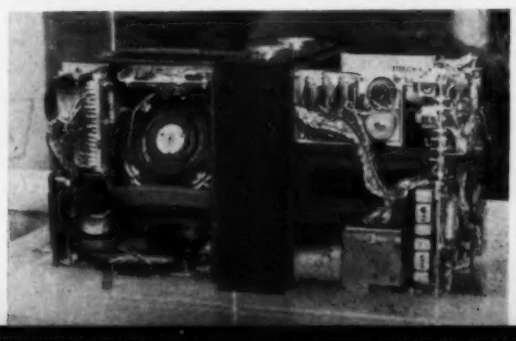
Another navigation-integrated system is the **Vinten** four-camera pod which is likely to become a standard CF-104 and F-104G fitting and therefore the subject of a very large order. Called Vicom, the pack houses and provides for four Vinten 70mm recce cameras, each with additional optics through which figures representing eastings and northings travelled from base and instantaneous heading are printed beside each picture. The information is automatically derived from the PHI navigation computer fed by the F-104G's Doppler inertial system. PHI is, of course, made by **Computing Devices of Canada Ltd** who also provide the camera setting and operating controls for Vicom. C.D.C. are Vinten's Canadian agents.

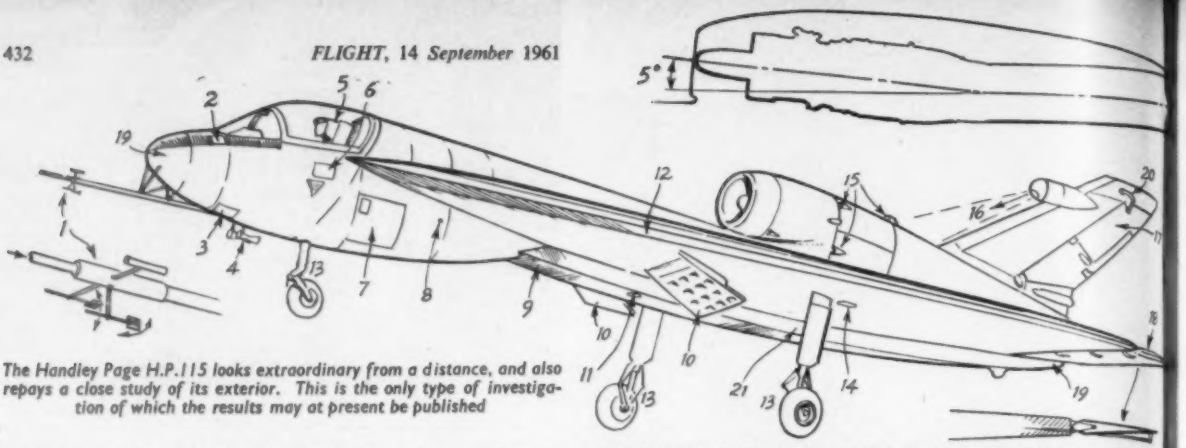
New to the master reference gyro field is the Bendix two-gyro stable platform which is to be made by **S. G. Brown.** The platform has two normal (non-floated) gyros of great accuracy and may be combined with a Bendix navigation computer. **Sperry** this year exhibited an actual twin-Rotorace reference gyro for which they expect to find a very considerable European market.

RAE moving-map pictorial presentation with a Doppler controller. Ferranti are making the production model



Bendix two-gyro, three-axis stable platform for master reference use. It is to be manufactured under licence by S. G. Brown



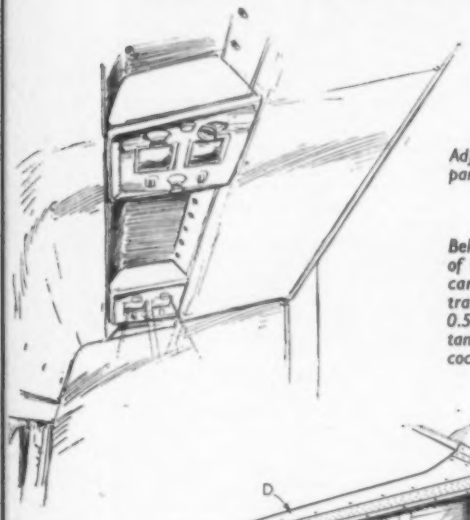


The Handley Page H.P.115 looks extraordinary from a distance, and also repays a close study of its exterior. This is the only type of investigation of which the results may at present be published

1, pressure sensing; yaw and pitch meter vanes; 2, rudder pedal access; 3, pressure system drains access; 4, twin venturis; 5, "One-off" Martin-Baker ejection seat: 6, canopy release handle; 7, battery and ground-test compartment; 8, dry-air charging point (3,300lb/sq in); 9, square-section underside; 10, air brakes; 11, refuelling point; 12, detachable leading edge for trial sections; 13, fixed undercarriage; 14, jacking point; 15, engine compartment cooling air; 16, camera to starboard wing; 17, fabric-covered rudder section; 18, fabric-covered elevons, tab-controlled; 19, ballast at front and rear; 20, mass balance; 21, battery compartment; the inset detail shows the angled thrust line of the BSV.9 engine

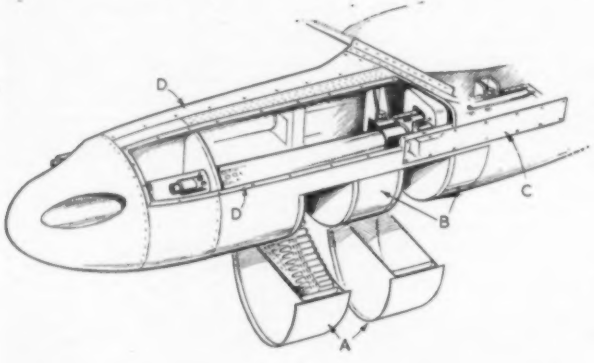
FARNBOROUGH SKETCH BOOK

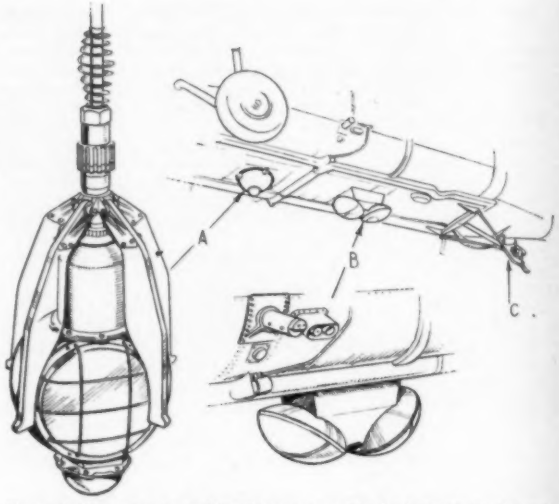
Points of Interest noted by "Flight" Artists



Adjustable passenger-service panels in the Avro 748 for Aerolineas Argentinas

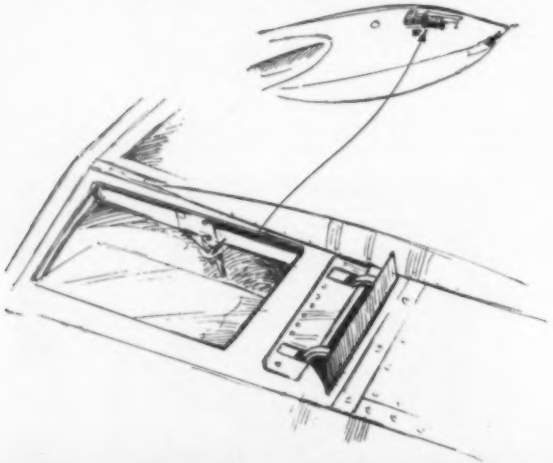
Below, a cutaway view of one of the gun packs which may be carried by the Folland Gnat trainer; each houses a pair of 0.5in Brownings: A, ammunition tanks; B, link chutes; C, gun-cocking access; D, gun access



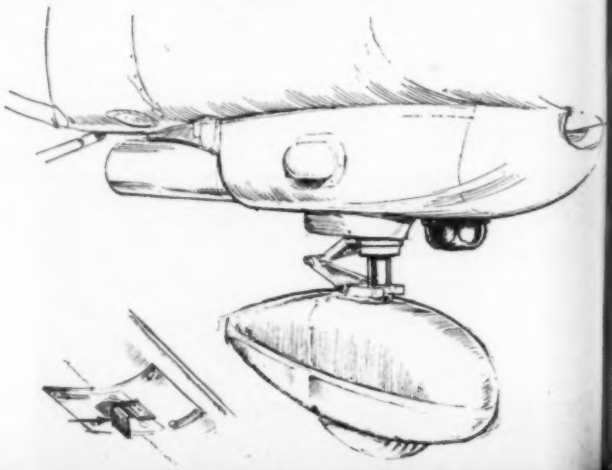


Never before seen in public, these are critical elements in the anti-submarine system carried by the Westland Wessex HAS.1. Of American design, the "dunking" sonar head (A) is made in the UK by R. B. Pullin, while the Ryan Doppler (B) is bought from the US. C is the towing hook, used to good effect at Farnborough

In the Handley Page Victor B.2 a problem was presented by the fact that a direct-vision panel must be incorporated in the acutely sloping windscreen (which virtually becomes the flight-deck roof). The solution is to employ a retractable deflector, as shown below



Below are two details of the Beagle A.109 Airedale. One of the two anti-collision beacons is mounted beneath the carburettor-intake (the ejector exhaust can also be seen in this sketch); and standard equipment includes a Safe Flight stall-warning blade, which moves forwards to operate the warning horn



ROUND THE STANDS . . .

Most of the items in the outdoor exhibition came under the general heading of ground-support equipment

Ground Equipment

A HANDSOME quartet of refuelling vehicles was shown by **Zwicky,** including the prototype "Kennet" hydrant dispenser for Shell-Mex & BP. The Mk 3 version of the Avon refueller, also for Shell-Mex & BP, this year features Zwicky's Aquascan water-detection, and has a water separator filter. Dominating the outdoor display was an airport approach lighting tower, in galvanized slotted angle by **Dexion.** The company is producing more and more angle with a galvanized finish for outdoor structures. Round the base of the tower was typical Dexion racking as widely used for stores purposes.

The full-scale cross-section of the civil Belfast, presented by **Shorts** (and referred to in last week's issue), showed the ingenious two-deck passenger/cargo accommodation offered by this very big transport. Attracting attention to the **Airtech** display was a retracting aerial, on one of this company's air-loadable containers, in this case housing a radio station. The company is now offering "Aircon" containers in a variety of materials, including plastic manufactured under licence arrangements with SPAIR of France. Airtech is also emphasizing its electronics products, and on show, exemplifying this aspect of the company's work, was an airborne selector unit for controlling target aircraft.

New from **Blackburn Aircraft** were adjustable side guidance rails on the air dropping platform, with roller conveyor, which was displayed complete with pallet equipment and parachutes. Blackburn's work in this field is the result of first-hand experience with Beverley development. Attracting interest on **Delaney Gallay's** stand was a fascinating display of the company's "Vibrashock" equipment in action: two trays of ping-pong balls were vibrated on a table, those cushioned by a Vibrashock mounting being virtually motionless. New from **H.M.L. Engineering** was a portable hydraulic test rig, known as the Minirig, with a flow of 1 gal/min at 1,200lb/sq in. This can be carried around by one man for quick hydraulic system checks that do not require a full-scale rig to be wheeled out to the aircraft. The Minirig is powered by a 1½ h.p. petrol motor or alternatively by an electric motor. H.M.L. say that this unit, together with their Mk V mobile test rig, provides a complete hydraulic-testing system for a small airline.

The **Ministry of Aviation** showed its rocket-launched free flight model (first shown at the RAE open day and a photograph of which was published in *Flight* for June 15). Dominating the MoA stand was the orange-and-white-striped propellant experimental rocket motor. The case was made by the spiral welding of high tensile steel strip by a process developed by **Bristol Aerojet** to MoA requirements. Units of this size are being used by the Rocket Propulsion Establishment at Westcott to study the problems associated with the burning of solid charges for ballistic missiles or space rockets.

A completely new unit in the **Houchin** range of ground power units was the "Recti-Hy-Cy" brushless g.p.u., which provides for all electrical starting and servicing requirements. One has been sold to Aero Ground Services of Schiphol. Among the **Lucas** equipment in the outdoor exhibition was an interesting new paraffin wash unit, a handy rig designed for washing and drying components during dismantling and assembly. It is fitted with a hinged Perspex window and access by hand is possible through two ports sealed with rubber flaps which close around the wrists, thus protecting the operator from paraffin spray while he is cleaning the unit with the spray gun or drying it with the air gun. New from **Rotax** was an actuator test rig suitable for checking no fewer than 80 types of electric actuator of four different makes. It is in use with the Ministry of Aviation, and other units will be produced in the near future. Being emphasized by **Microcell Ltd**, and having attention drawn to it by an eye-catching fuselage cross-section with passenger seats installed, was the company's new "Crestafoam" material for seats. This is a flexible microcellular polyether foam developed specifically for comfortable cushioning. **Spurling Motor Bodies Ltd** showed two of their "stairways to the airways"—one for British United, an extending passenger stairway integrally mounted on a Bedford van, and a towable extending stairway for BEA. A useful feature of the latter unit is that it can be adjusted to the height of any aircraft by turning a handle until the right number comes up in a "window" according to an aircraft index near the handle.

British Oxygen were giving demonstrations of the way in which the lox 3½ litre-system of the Gnat is refilled, and the company showed also its range of storage tanks and a gaseous-oxygen producing plant with a capacity of 1,000 cu ft/hr at 2,000lb/sq in. **Morfax** showed their range of engine maintenance stands, and though it was not actually in the equipment park, the stand on which the Blue Streak was exhibited was also made by Morfax—a structure designed for the show, and which was stressed for possible high wind loads on the exhibit. For those who want to cut holes in concrete, for the insertion of such things as runway lights, **Van Moppes** were demonstrating their diamond drilling tools.

Hydraulics

WHILE 1961 cannot be said to be a particularly exciting hydraulic year, it has not been without its highlights. The ICI conference on silicone fluids in April (reported in *Flight*, May 4) was a pointer to one of the big changes that are likely to sweep through the entire hydraulics field—the application of DP47 (Silicodyne H) fluids to new systems for new aircraft.

There are two main reasons for this, and the increased temperature range which silicones offer is not necessarily the most important. Though staggeringly expensive, DP 47 is possibly safer and certainly more easy to handle than the Skydrol fluid which is at long last becoming the industry's standard for new line aircraft. It presents many problems in equipment design, but only at very high, and possibly at very low, temperatures; over the present ranges of hot and cold over which civil aircraft operate it is as good or better

Lockheed (Automotive Products) manufacture the nose leg for the de Havilland Trident, pictured here flanked by a main-leg stay

ROUND THE STANDS . . .

than anything yet developed. When provision does have to be made for extremes of heat and cold—and in military operations the temperature envelope is expanding all the time—silicone fluids are suitable for −52°C cold to +250°C hot. This is an advance that makes the Achilles' Heel of hydraulic development not the fluid but the seals which contain it.

With this background in mind, pace-setters at Farnborough were two Buccaneer units shown by **Electro Hydraulics** on the **Owen Group** stand, placarded as being suitable for operation on DP47. Externally, there was no sign on either piece of equipment—one a wing-flap servo, the other an airbrake selector valve—of special development for compatibility with the new fluid; of stainless-steel pipes, welded connections and couplings, more-rigid-than-usual design there was no visible evidence. And as one jack bore the date stamp "1959" perhaps this was not to be expected. The working temperature range of these units is unexceptional, and they are in fact of quite standard design and equipped with normal butadiene acrylonitrile seals. The significance of their display was that they were the only units on show publicly to be associated with the new fluid, but that alone should be sufficient to justifiy their pride of place.

The year's other major development is perhaps more of mechanical than strictly hydraulic interest. This Farnborough, the ball-screw jack was definitely *in*, replacing in many applications (undercarriage excepted) the piston jack which has previously been used. Behind this change is the argument that a central, duplicated hydraulic motor rotating high-speed shafting coupling several ball-screw jacks provides better synchronization and greater integrity than individual hydraulic rams, however carefully the latter may be phased.

For civil use, the safety advantages and close control of output displacement make the system attractive enough to outweigh the installation problems of rotating shafts; and the high-efficiency ball-screws, with their ratchet devices providing irreversibility, are a very different proposition to screw jacks with Acme threads. **H. M. Hobson** say that the "no-back" ratchet device on the Trident leading-edge jacks has a backlash of only 0.015in, quite insignificant in the positioning of a control surface. A similar jack is being developed for the Caravelle 8.

This firm also showed a small worm-driven flap unit of substantial construction which again appears to be one of a number operated from a common shaft. The application is obviously military, and the body was machined from a block of titanium.

Hydraulic power packs have been much in evidence lately. Hobson and their associated company **Integral** manufacture such units for the Handley Page Herald and for the Argosy. And, although not a new unit, the flap-motor unit for the latter aircraft has been developed to overcome an excessively high noise level which had previously led to a good deal of criticism. The trouble lay in the provision of a small stand-by hydraulic motor which functioned only in emergency, but rotated at about 12,000 r.p.m. on every occasion upon which the motor operated. Replacement of this by a second motor of the same size as the new unit, and rotating at only about 2,500 r.p.m., has effected a cure.

Very new indeed was the hydraulic power pack for the Beagle 206 on the stand of **Lockheed Precision Products,** a company which is obviously now closely associated with the industry's new light aircraft enterprise. Prototypes or early production models of Beagle hydraulic equipment, all with light-alloy bodies machined from the solid, were shown alongside a similar range of parts—mainly for the nose and main undercarriage legs—of the D.H. Trident. Though presumably tightly limited on price, there was no evidence that any of the Beagle equipment was in any way less carefully built or finished than that for de Havilland's twin jet. Apart from the familiar oleo legs, drag stays, uplocks and so on that comprise a typical undercarriage, Lockheed's contribution to the Beagle includes main and nose undercarriage spring boxes designed to assist this free-falling design.

All Beagle hydraulic equipment operates on DTD 585, and the same fluid will presumably be used in an undercarriage which Lockheed are developing for another new British light twin—the Halcyon. Lockheed had the only reference to this aircraft anywhere in the Exhibition, thus associating themselves uniquely and closely with light aircraft design in this country. Meanwhile, they continue to design hydraulic equipment for civil transports, the Trident equipment on display being the latest example of a long line of Lockheed undercarriages. On show were a nose-wheel strut, main undercarriage side stay, nose-door jack, undercarriage selector dump valve, and a nosewheel steering jack of hefty proportions.

Another undercarriage designer with a development interest in nosewheel steering was the **Dowty Group**, who showed on a demonstration rig some of the work that they have been doing on the electronic control of nosewheel steering. The display undercarriage steered through ±35° and had an automatic centring facility over ±87°. Mounted on a small control panel in front of the undercarriage leg was a control knob and pointer registering against a graduated scale, a sensitivity switch giving selection of coarse or fine control and a retraction lever with indicator lights—the last-named to demonstrate how centring occurs as the undercarriage is retracted. Response appeared to be good, and the electronics required very modest in dimensions.

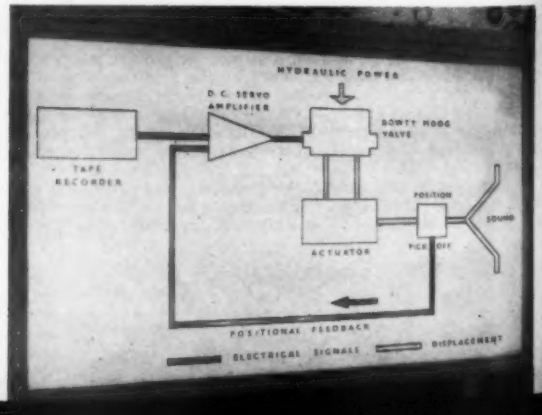
Flying controls, a specialized branch of hydraulics engineering described in another section, cover most of the work currently being undertaken by **Boulton Paul.** The Wolverhampton firm remain firmly in the hydraulics business, however, and had on their stand a piece of hardware that is used in launching Seacat. This was an interesting exercise in combining the careful refinement of the Boulton Paul variable-displacement pump with a fairly simple hydraulic amplifier. This marriage of sophistication with simplicity should add up to a reliable and useful unit.

Most British hydraulic engineers are now familiar with the Dowty two-stage, flow-control Moog valve, manufactured under licence from Moog Servo Controls Inc of the USA, but the virtues of this clever design were pressed home with a convincing demonstration of its good response characteristics. A signal from a tape recorder was passed through a DC servo amplifier to a Moog valve supplied with hydraulic power. In response to this signal, the valve controlled an actuator and thence sound from a loudspeaker; information on extension of the actuator being fed back into the DC servo amplifier. Quality of sound reproduction as controlled by the hydraulic valve was outstandingly good. Two types of Moog valve are now produced by Dowty, and they differ only in the diameter of the hydraulic port circle and the size of the second-stage sliding spool. The larger version has a greater maximum flow capacity, the smaller a high dynamic response.

Other manufacturers had more generalized equipment on show, such as **Mitchell Hydraulics** general purpose jacks, **Sperry's** Vickers Inc hydraulic motors and **Avica's** swivel couplings. The last-named are used on the Bristol 188 and on the spoiler system of the VC10, where they pass fluid at 3,000lb/sq in. Operating on Skydrol 500, they combine a long life with satisfactorily low torque values.

Left, Hobson screwjack for the Trident drooping leading edge. Right, the Integral hydraulic powerpack for the Herald and Argosy

Diagram of the Dowty-Moog servo valve with an audio (loudspeaker) output plus a feedback loop, demonstrating fidelity of output



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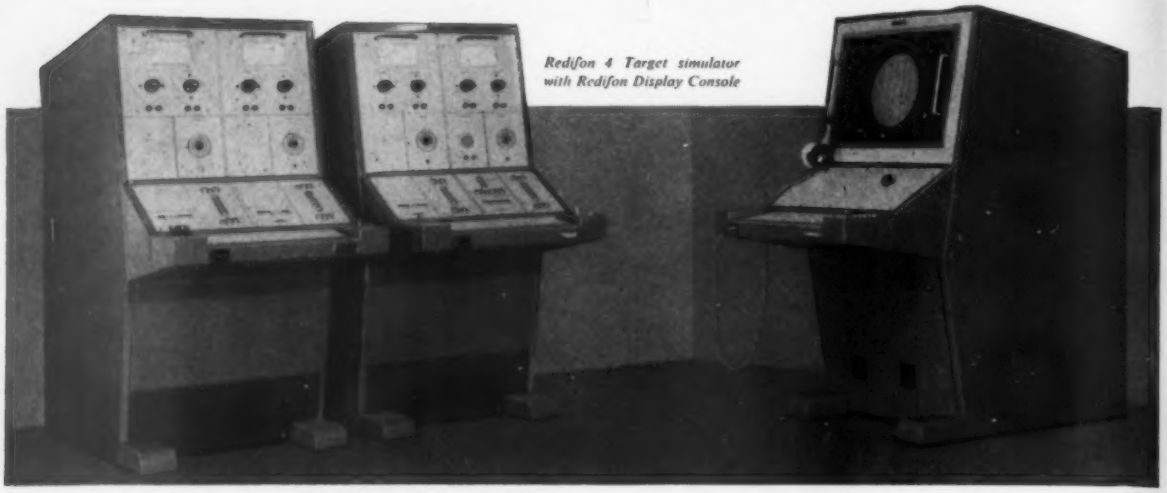

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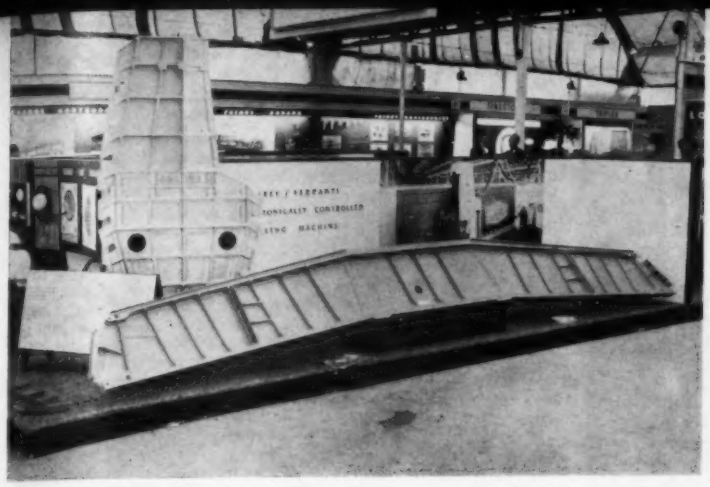
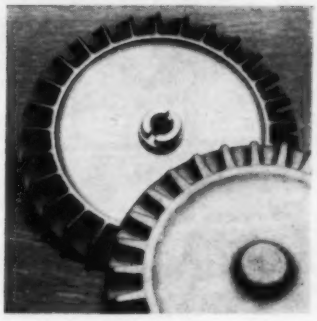




These two photographs have been chosen to illustrate outstanding current practice in the fields of sheet-metal work and heavy machining. The latter is typified by the centre-section spar for the Gannet AEW.3 and centre-tailplane skin for the Trident, both of which would be viciously difficult to make on any machine other than the tape-controlled Fairey/Ferranti. The stand of a little-known company was selected to show what beautiful airframe and engine components are now being produced in stainless steel, Nimonics and titanium alloys

Right, turbine wheels for the Rover TP/90 turboprop are machined by Firth-Derihon, from a single blank forged in Nimonic 105

Materials and Processes

DISPERSED amongst the spacemen and electronic black boxes was a profusion of down-to-earth revelations of new materials and new methods of production and inspection which amply repaid the diligent search needed to track them down. Some of the most prominent exhibits in this category—notably the impressive machined parts for the VC10 on the BAC stand, and those for the Trident and Gannet AEW.3 milled on the Fairey/Ferranti machine—are merely bigger and better examples of familiar techniques. This report concentrates upon things which are quite new.

Probably the most noticeable trend in the field of raw-material supplies is the marked increase in interest in vacuum-melted steels. The physical properties of modern alloy steels are becoming so high that consistency of quality is increasingly vital if they are to be used to their limit. Melting in a vacuum ensures a completely homogeneous and inclusion-free material which enables specification requirements—particularly those of ductile and fatigue resistance—to be more accurately maintained. For research or production that requires small quantities of metal, a number of buckets containing the alloying elements can be placed in the vacuum chamber to feed the furnace.

Although this approach to vacuum-melting is the ideal, the size of the installation becomes prohibitive when large masses of steel must be melted. An interesting alternative approach has been made by **Firth Brown** who have developed a consumable-arc method. This process is used for further refining of steels made by normal electric techniques. Ingots from 12in to 26in diameter, weighing from 1,120lb to 7 long tons, are available from this supplier. They are in demand for aircraft gas-turbine discs, special bearings and where similar exacting requirements must be met. Examples of such products were very much in evidence on the associated stand of **Firth Derihon.**

Jessop-Saville's new nickel-based alloys G74 and G84—which have improved creep rupture strength and oxidization resistance, and are therefore eminently suitable for turbine rotor blading—and the **United Steel Co's** seven new alloy steels are all melted under vacuum conditions. Of the seven USC alloys, the Fox series HST.100, 120 and 140 are possibly the most outstanding. The u.t.s of HST.140 is 140 tons/sq in at room temperature, and is still 137 tons/sq in at 600°C.

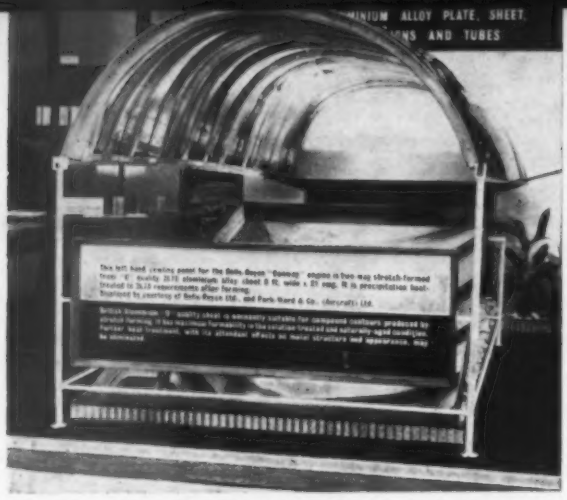
An interesting material developed by the **English Steel Corporation** is their D.50, a ni-cr-vanadium corrosion-resistant steel with a minimum u.t.s. of 100 tons/sq in. It is hardened not by normal heating and quenching methods, but by freezing to −78°C. Distortion is thereby reduced. It is under active consideration for use as a material for undercarriage members.

Apart from exhibits of the more sophisticated "new" metals, such as wrought beryllium and niobium, the **ICI Metals Division** showed an alloy-steel component for a Blackburn aircraft (Buccaneer?) machined from a **High-Duty Alloys** forging. This was in Ex.013C, which has good room-temperature strength and creep resistance.

Even though other metals are coming into more widespread use, aluminium and its alloys will undoubtedly remain the major structural material for many years. To cope with demand for still larger sheets, a number of suppliers are installing new equipment. **Alcan** have recently brought into operation a 144in hot mill to complete their facilities—which include heat-treatment, stretching, sawing and ultrasonic inspection plant—for plate production to this size. At present this is the largest aluminium rolling mill in Europe, but an even larger four-high mill, capable of handling material up to 148in wide, should be in production at the works of **James Booth Aluminium Ltd** by the end of the year.

The principal aluminium alloys in use for aircraft sheet-metal work have been BS.2 L.72, and its close-tolerance equivalent DTD. 710A. Problems of stretch-lines and the "orange-peel" effect have always been present when these materials have been subjected to double-curvature stretch-forming. **British Aluminium** have produced their "U-quality" alloys, which give increased ductility and

This machined forging—for a Blackburn aeroplane which is certainly not the Beverley—starts as an obviously difficult forging in Ex013C, an alloy which has not previously been divulged; the forgers were High Duty Alloys



The left-hand pod cowling for a Rolls-Royce Conway shows the sort of double-curvature component which can be stretched-formed in the new British Aluminium "U" quality sheet. No stress-lines could be discerned

enable many parts to be made without intermediate solutionizing.

Turning from materials to their manipulation, it was encouraging to see a number of developments in the fields of casting, forging and moulding. Most exhibits were excellent examples of existing techniques and metals, but both High Duty Alloys and **Precision Forgings Ltd** (formerly Garringtons) were showing cold forgings to extremely fine limits. **J. Stone & Co (Charlton)** had a shell moulding in L.124 having channels with an extremely high depth-to-width ratio.

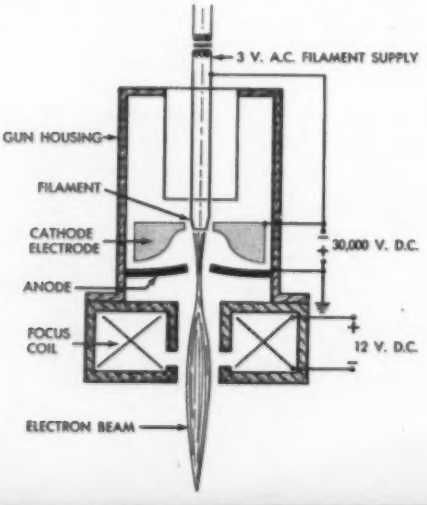
Accles and Pollock have added a new precipitation-hardened stainless steel, FV520(S) to their already extensive range of tube materials. This is in the 80-ton u.t.s. range, and has an elongation of approximately 25 per cent. Apart from normal products, this firm displayed a special super-flexible tubing. Instead of the usual upright-and-inverted "U" section, this type is of figure-of-eight form. It is available in stainless or plain steels, and is suitable for all low-pressure applications.

Probably two of the most intriguing exhibits for the production engineer appeared on adjacent stands. The butt-welding of tubing always presents difficult problems, especially if their diameters are small. The parts must often be aligned by hand, and welding takes place in a number of short runs, leaving uneven spread of metal and many potential crack-starters. These difficulties can be overcome by using the orbital welder developed by **Palmer Aero Products Ltd.** Here the two tubes are held in special clamps, and a welding torch moves round their joint-face at a predetermined rate to produce a uniform weld. Apart from accuracy, exact repeatability is ensured by this means.

Normal welding methods tend to heat considerable areas of the parts that are to be joined. This is kept to an absolute minimum by a new fusion process displayed by **Sciaky.** The edges of the metal are heated by bombarding them with electrons. The operation, which is carried out in a vacuum chamber, is very precise, and can be used on refractory or highly oxidizable metals. Among the many examples on display was a cap welded inside a tube. The material for each component was beryllium and an orbital weld had been successfully carried out on a total thickness of 0.055in.

Among the many fasteners of different forms and materials that were on show this year were two wholly new devices. Insulgrip fasteners, exhibited by **George Goodman Ltd,** are available in two types, for square fixing or two-round-hole fixing. They can be

This diagram clearly shows the basic principle of Sciaky electron-beam welding equipment, which is described on this page



inserted from one side of the part, are self-locking and, being made of nylon, are electrically insulating and re-usable. Where removable panels must be employed in a skin that carries shear, it can be a major problem to replace the part once it has been removed. Milson structural panel fasteners, manufactured by the **Unbrako Socket Screw Co,** permit misalignment of holes up to 0.060in. As the screw is inserted, the parts are drawn into line.

Three new two-part sealant compounds are available from **B. B. Chemical Co Ltd.** The two Viton compounds are for use in integral-tank areas, one for brushing on the mating faces, the other for a sealing bead along the edge of the joint. Since it contains no solvent, the third substance, a silicone-rubber, is more suitable for cabin sealing. All three will withstand temperatures of 250°C.

Plastics, both raw materials and products, continue to expand into further fields. **Fothergill and Harvey** showed new glass-fibre materials, pre-impregnated with both epoxy and polyester resins.

A more advanced method of thermal and acoustic cabin insulation is being supplied by **Fibreglass Ltd** for the VC10. Special panels are in production, moulded to the curvature of the fuselage and sealed against moisture, which serve the additional function of air ducts. Current practice will be to hide this material by the furnishing trim panels, but both will later be made together.

Further products involving the use of glass-fibre were displayed by **Bristol Aeroplane Plastics.** A clever wax-core moulding technique is used for the fluted C- and X-band radomes for the Britannia. Exceptional erosion resistance and radar response are claimed for these components. Bristol also make glass-fibre pipeline sections and unions, which display the good mechanical and chemical properties of this material and which will find many uses in industry.

Slippery floors can be made safe by coating them with a special resin newly developed by **Bakelite Ltd.** This firm are the source of a wide range of materials for use in new Beagle aircraft, and are supplying Microcell Ltd with Warerite sheeting to face their plasticell-foamed p.v.c. for non-structural bulkheads. Warerite bonded to aluminium was also on display.

Seals for use with the new Silcodyne and Skydrol hydraulic fluids were seen on the stands of **Precision Rubbers** and **Dowty Seals.** By selection from the various products available, temperatures in the range −60° to 200°C and −60 to 150°C can be accommodated.

A filler compound for rubbers that one feels must have many applications has been produced by **Plessey.** This can be added to any rubber-based material to make it electrically conducting. The de-icing of pitot-tubes, and R/F shorting across a door-seal are examples of where this principle could be used.

Rubber is also used as a bonding medium between two alclad sheets to produce an interesting material known as Hycadamp. It is a product of **Fireproof Tanks Ltd,** and can be worked as though it were metal. It extends the fatigue life of structures which fail by vibration (for example, areas affected by jet efflux); it reduces the transmission of vibration, and can be used to control structural resonance. Although its shear strength is only 92.5 per cent of the same weight of alloy, its strength in bending is greater (115.7 per cent).

Rubberized hair, crimped in an entirely new manner, is employed by **Hairlok** as a freight-packaging substance. It is claimed that 1lb of the new Texlite gives better protection than 2lb of ordinary rubberized hair.

Knitted, crimped, rolled and compressed stainless-steel wire has been employed by **Delaney Gallay** as the absorption medium in their Vibrashock isolator mountings.

Many new products were displayed on the stand of **D. Napier & Son Ltd** (*not* part of Napier Aero Engines Ltd). These included a number of applications for the Spraymat electrical de-icing system, probably the most difficult application being for the main-rotor blades of the Westland Wessex. The firm are also licensees for the manufacture of the Sierracote and Sierraglo processes. The former provides heating for aircraft windscreens and canopies of either glass or plastics. It can be curved after application without damage. Sierraglo is a process for illuminating instrument panels. By supplying current to the coating, the panel itself lights up in white, green, yellow or red, depending on the phosphor used. Napier also displayed Plexiglass 55, a processed acrylic sheet with greater toughness than is normal with such material.

Equipment for the inspection both of raw material and finished parts was again much in evidence. Apart from showing an increased range of dividing tables, **Optical Measuring Tools** demonstrated their new 15in Universal Projector, with which component magnifications of 10, 20, 50 and 100 times can be obtained.

New developments in the fields of magnetic and penetrant flaw-detection inks were exhibited by **Manchester Oil Refinery (Sales) Ltd,** in particular for use in testing storage vessels. Also shown for the first time was the Italian Minispot X-ray flaw-detection machine which, though weighing only 68lb, is capable of detecting flaws in 1in-thick steel or 4in-thick aluminium.

An eddy-current and ultrasonic test rig for discovering flaws in tubing has been produced by Accles and Pollock. The part is inserted in an open-ended block and any errors produce changes in the shape of the trace on a cathode-ray oscilloscope.

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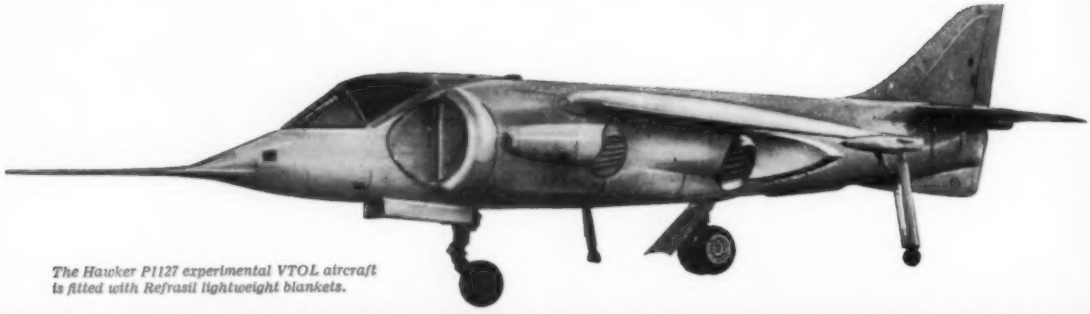
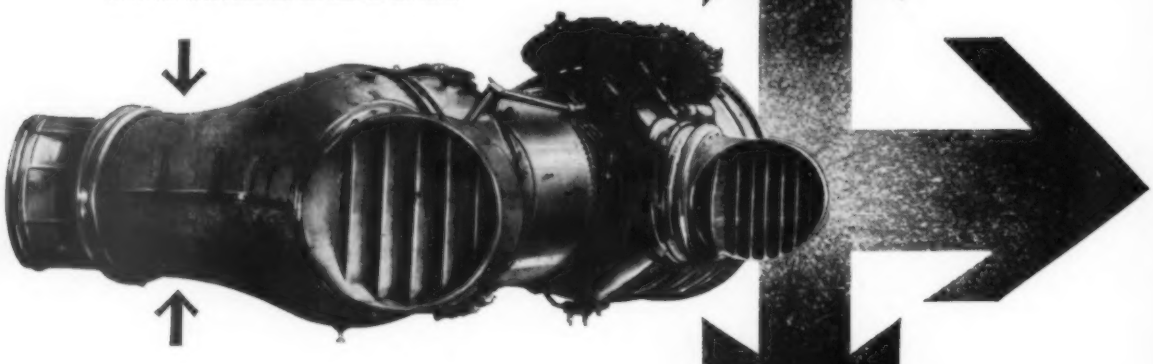
BRITISH EUROPEAN AIRWAYS

Flight, 14 September 1961



The Hawker P1127 experimental VTOL aircraft is fitted with Refrasil lightweight blankets.

The P1127's Bristol Siddeley Pegasus lift/thrust ducted fan engine features movable jet nozzles for vertical or horizontal thrust. Note Refrasil blankets (Arrowed)



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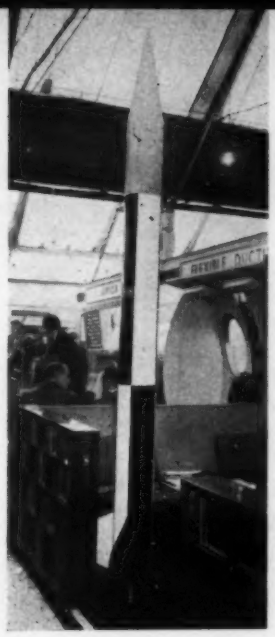
ROUND THE STANDS . . .



Left, the Bristol Aerojet flight test vehicle discussed on page 438; below, Royal Navy ratings load a Seacat quadruple launcher

Missiles and Space

PERHAPS the most charitable thing that can be said about the United Kingdom's accomplishments in the field of space research is that they are reminiscent of an iceberg; there is little to show on the surface, but a very great deal is going on underneath. At Farnborough de Havilland's **Blue Streak** stood like a silver cathedral in a shanty town. Beside it de Havilland Aircraft suggest that the future of this ballistic work-horse as a first-stage space booster is "virtually assured."

As discussed in the detailed description of Blue Streak published in *Flight* for August 17, propulsion is provided by a Rolls-Royce RZ.12 installation, comprising a pair of individually controlled RZ.2 engines operating on liquid oxygen and kerosine. Rolls-Royce were able to display a complete RZ.2 Mk 2 engine at Farnborough, the first time that any Rolls-Royce rocket engine has been publicly exhibited. The engine is rated at 137,000lb thrust at sea level, and "current work will increase this to 150,000lb." After initial trials at the RPE at Westcott, development of the engine has been centred at Spadeadam, and already more than 400 static firings have been accomplished on complete engines.

Two models of a possible **European three-stage satellite launching vehicle**, using Blue Streak as the first stage, were displayed in the exhibition hall, one by the Ministry of Aviation and one (with the vehicle mounted on its ground launcher) by Hawker Siddeley Aviation. Designs for possible communications and astronomical satellites, first shown in model form at the RAE Open Days earlier this year, were again illustrated on the Ministry of Aviation stand.

Of all Britain's guided weapons, only **Bloodhound 2** has succeeded in becoming accepted as standard armament in the service of a neutral foreign nation. Larger and more lethal than Bloodhound 1, this new surface-to-air missile is at present in the development-firing stage, and the performance of the new AEI/Ferranti continuous-wave guidance system is extremely encouraging. Bristol emphasize the "package deal" which they can offer, which matches the requirements of the most demanding customer and may have been instrumental in clinching the big deals with Sweden and Switzerland.

Backed by the resources of HM Government and many hundreds of sub-contractors, the basic Bloodhound team comprises Bristol Aircraft, Bristol Siddeley Engines, Ferranti, AEI, Decca Radar, EMI (Electronics) and ML Aviation, with the first-named acting as weapon-system manager. The team can supply: missiles, launchers, target-illuminating radars, launcher-control posts, power supplies, handling equipment, servicing, communications, data handling, and tactical-control equipment; installation of all equipment, and commissioning, including demonstration of integration of the system with tactical-control systems; maintenance and servicing equipment (integrated with the customer's existing facilities); training of the customer's personnel in operation and maintenance; technical and commercial studies to meet customer requirements; and the provision of field-support teams.

"The Army must have the best possible anti-aircraft protection. We believe that **Thunderbird 2** answers this requirement better than any other system." So said the Secretary of State for War last November 7. As is the case with Bloodhound 2, no data or illustrations may yet be published, but it can be said that the principal advantages of this missile are: continuous-wave guidance, which gives greater range, improved effectiveness against targets at very low and very high altitudes, and increased resistance to electronic countermeasures; and improvements in the fields of mobility and logistics, reflected in air-portability of the complete system, automatic operation, "self-contained capability of independent operation," greater speed into action, reduced numbers of personnel and vehicles and simplified storage, maintenance and repair. Thunderbird 2's development firing programme has been successfully completed, and acceptance trials are due to start in the near future.

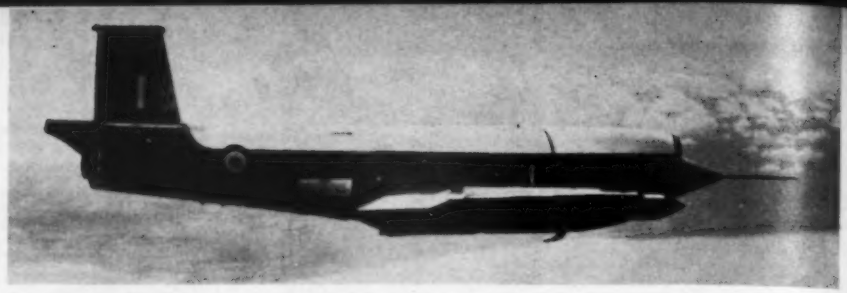
The forerunner, Thunderbird 1, has now been in service with the Royal Artillery for two and a half years. Its mobility and flexibility have been amply proved; regiments have been deployed in "many places in the United Kingdom and Europe" in all weathers by day and by night, and batteries are at present being deployed on unprepared sites under true field conditions. During recent trials the Royal Artillery have achieved about 90 per cent success—a claim which probably refers to firings from the range at Ty Croes.

A half-scale model of the first joint US/UK **ionospheric satellite** was displayed by British Aircraft Corporation, together with items of instrumentation for this satellite which have been designed and built by Bristol Aircraft Ltd. These units comprise an extra-high-tension generator, used in place of dry batteries to provide a stable supply of about 1,600 volts for proportional gas counter tubes; and the electronic section of an X-ray spectrometer. These were developed for the space research group of University College, London, and the University of Leicester.

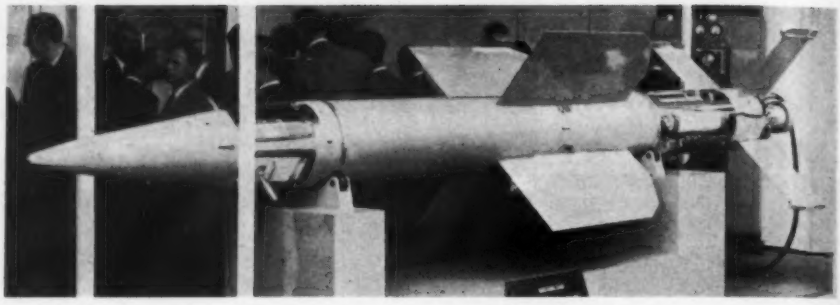
The Ministry of Aviation space exhibit disclosed that the **Skylark** rocket "is now being used to test experiments in aid of the UK/US Scout satellite programme," and that "nearly 40" Skylarks have now been fired at Woomera.

It is generally agreed by almost every nation possessing an army that the greatest single weapon requirement is for a missile which can be used by infantry with complete effectiveness against any armoured vehicle. Vickers-Armstrongs' **Vigilant** is widely accepted as seeming to be precisely what everyone is looking for; but it has now reached the most critical stage in its career, in which everything depends upon the willingness of British Aircraft Corporation to put every ounce of effort behind it, appreciating that the huge prizes which it could undoubtedly win will have to be striven for. Compared with its competitors—of which the French Entac is the most formidable—Vigilant is considerably more advanced in concept. Its inbuilt autopilot, aerodynamic design and other features make it far easier to control, greatly reduce the number of firings needed to acquire and retain proficiency, and enable it to be used at very large angles-off and against targets at very short range—with better accuracy at all ranges. It is up to BAC forcibly to demonstrate that these advantages more than compensate for a price-differential of at least 2 : 1.

This could be done only if actual experience by a customer showed such a claim to be justified; and the British Army have already gained such experience. Vigilant has now completed its War Office infantry trials, the main purpose of which was to decide whether or not a wire-guided missile of this type is preferable to the several alternative types of possible anti-tank weapon. This has been established beyond any doubt; and, at the same time, Vigilant has gained for itself an almost universal acceptance as the best such



An air-to-air photograph of a Government Aircraft Factories/ Fairey Engineering Jindivik Mk 102B target, during a recent mission from Llanbedr (the airfield which serves the requirements of the missile range at Aberporth)



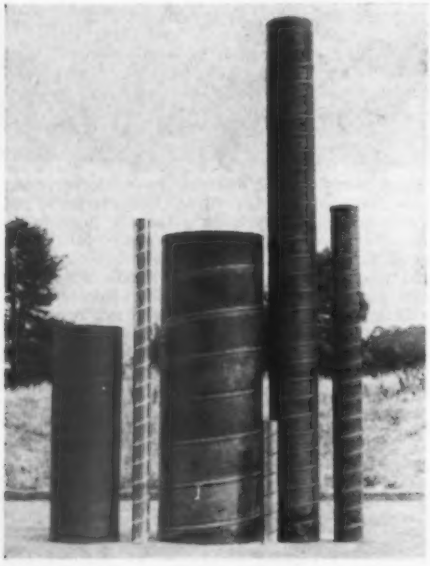
Briefly discussed in last week's issue, the Armstrong Whitworth Seaslug Mk I has now all-but completed its development programme and has shown itself to be an exceptionally accurate weapon. This yellow-painted example was displayed at Farnborough in company with a more operational white-painted version fitted with its forward-mounted boost motors

ROUND THE STANDS . . .

missile in the world. As the procuring agency, the Ministry of Aviation are this month starting a technical evaluation, which is being combined with tactical trials by the Royal Armoured Corps in which Vigilants will be deployed from Ferret scout cars. These trials are due to finish before the end of the year. On technical grounds there is no doubt about the outcome; the future of Vigilant depends upon economic factors, and upon the ability of its sponsors to grasp the huge prize which appears to be attainable.

A high-altitude, **solid-propellant sounding rocket** under development for the Meteorological Office was exhibited by Bristol Aerojet. This will measure wind, pressure and humidity data at heights up to 200,000ft, carrying a nominal payload of 10lb excluding the nose-cone. The motor case may be made from helically welded 100-ton steel or glass-fibre; examples of both were on display. The rocket is 7ft 6in long, weighs 81lb, and has a burn-out altitude of 48,000ft. Other data include: all-burnt weight, 31.5lb; maximum velocity, Mach 4.3; initial acceleration, 50g for 0.2sec; flight acceleration, 12g maximum; launch velocity, 300ft/sec.

A range of examples of cases for solid-propellant rocket motors fabricated by the precision-welding of helically wrapped steel sheet. Such cases were mentioned on page 374 last week



A simple launcher has been designed for use with the Bristol Aerojet meteorological rocket, consisting basically of a 32ft long tube supported on a hinge and raised by a hydraulic strut, and lowered to a near-horizontal position for loading. The use of additional boost motors for take-off is envisaged.

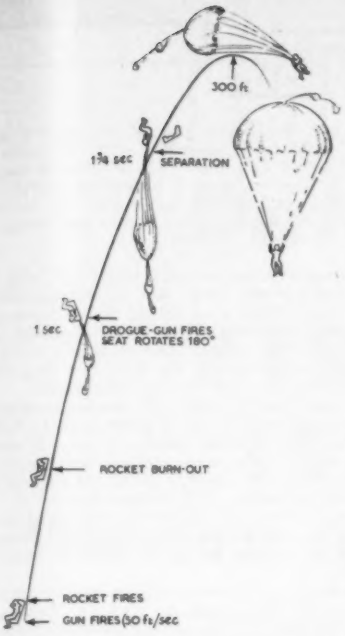
Also exhibited by Bristol Aerojet was a larger solid-propellant **flight-test vehicle** said to be typical of a range of such rocket vehicles developed for the Royal Aircraft Establishment and Rocket Propulsion Establishment. The instrumented payloads of these test vehicles are normally recovered after descent by parachute.

Almost completely absent from the SBAC Show were the Tigercat and the Seacat 2, both of which are private ventures by **Short Brothers & Harland.** This was more than compensated for by the wealth of new material available on the present Seacat 1, which is becoming accepted by many navies as the only available weapon system for close-range defence against aircraft (or surface targets) of carriers, frigates and destroyers. Less than 5ft in length, Seacat 1 has a boost/sustainer solid motor, command guidance and a large warhead with both contact and proximity fuzes. Particular features of the design are the ease with which it can be accommodated in existing ships—even quite small craft of down to a minimum of some 500 tons displacement—and the ability to be held at constant readiness and to maintain a relatively high rate of fire. Although the shipboard equipment can be integrated with British or foreign blind-fire directors, the installations now entering service with the Royal Navy, and subjected to arduous sea trials aboard HMS *Decoy* (a *Daring*-class destroyer), has the purely visual system first exhibited at Farnborough in 1960. The shipboard equipment (Blue Tallies) consists of a Mk 10 visual director, a radio transmitter, a quadruple Mk 20 launcher, a launch-control console, and a power and monitoring unit for missile testing. The missile is stored enclosed in a rigid glass-fibre canister supported inside a light tubular cage which can be hoisted and stacked. This cage also serves as the transport pallet, and a collapsible version is used for ship-to-ship transfer at sea.

Manufactured by Rose Brothers (Gainsborough), the Mk 20 launcher carries four missiles disposed around the transmitting aerial. The launcher automatically rotates and elevates its Seacats to follow the corrected bearing and elevation of the Mk 20 director up to the moment of firing. The four missiles can be loaded in less than three minutes, and are protected at sea by individual non-porous and hermetically sealed sheaths of rubberized plastics material through which the missile can be launched without ill effect. Seacat depot equipment (Red Tallies) comprises a number of test sets and auxiliary equipment, all of which were on display. The missile test stand simulates a launcher platform, and provides hydraulic and electrical supplies to the missile under test (a fixed hydraulic power unit is mounted adjacent to this stand in order to conserve the Seacat's own oil supply). Close by is the overall test set, consisting of two modest cabinets which provide all the supplies, signals and instrumentation needed for checking out missiles before delivery to a ship. The missile itself was exhibited in considerably cut-away form (it had previously been seen "exploded" at the Paris Salon), and it was possible to examine the potted electronics package disposed between the big warhead and the four servos which drive the moving wings.

Two views of the Baxter, Woodhouse & Taylor Windak full-pressure suit, showing the mobility of arms and head achieved. Note the ribbed harness and straps by which suit and helmet can be tensioned down, away from the head while the suit is inflated

Personal and Safety Equipment



Operating sequence of the spectacular Martin-Baker rocket seat. A low-velocity (50ft/sec) gun is used. Existing seats can be retro-fitted

ONE of the most sensational items in the flying display was, of course, the "zero-zero" ejection demonstrations with the new **Martin-Baker** rocket seat from the back of a lorry. This technique was gallantly demonstrated live at Paris earlier this year by W. T. H. Hay, but even a dummy ejection is a rare and impressive spectacle. Martin-Baker released some information about the operation of this device, most important news being that the rocket can be retrofitted to existing seats. The ejection sequence itself is relatively little altered. The older and gentler two-tube, 50ft/sec gun is fired in the normal way and the rocket fires for less than a second towards the end of the stroke of the gun. As the seat leaves the aircraft, two mechanical timing devices are triggered by static lines, the first of which fires the drogue gun one second after ejection. The seat is by then near the top of its 300ft trajectory, still upright, but the drogues flip it over, bottom up. Three-quarters of a second after the drogue gun fires, the separation sequence is initiated and the drogues extract the main parachute canopy in the normal way, the whole canopy deploying during the upward flight of the seat. By the time the whole assembly arcs over and begins to descend, the seat has departed upwards and the man is suspended under the main canopy.

To keep the seat upright and avoid tumbling or deflection of the trajectory, the rocket must fire through the c.g. of the man-seat combination. The thrust-line of the rocket unit is therefore adjustable and can be set to a number predetermined for each pilot on a special weighing scale. Each pilot has his number and sets the seat accordingly before take-off.

Martin-Baker also exhibited the Mk 4MSA seat for the Buccaneer and a Mk H5 for the McDonnell F4H Phantom. New this year is an explosive guillotine device for separating the automatics from the parachute if manual override is used.

The **Folland**/G.Q. operating sequence for their Mk 4 ejection seat for the Gnat trainer is slightly different and G.Q. displayed the three-stage stabilization system. The man leaves the seat shortly after ejection and a 30in vane-type drogue is deployed to provide initial deceleration and positioning. The drogue has no rigging lines and contains in a central tube the canopy of the main stabilizer, which has a flying diameter of six feet. The small drogue is jettisoned after three seconds, allowing the stabilizer to deploy, and a barometric device then controls the release of the main stabilizer from the harness so that it can extract the main canopy. The seat-parachute combination is cleared for ground-level ejection at speeds down to 90kt. Manual override involves mechanical guillotining of connection between drogues and main canopy. This has been successfully tested in a live drop. Live ground-level ejections will be tried next year. A feature of the G.Q. harness is an apron round the man's chest which streamlines his body, gives some blast protection and prevents loose strap-ends from flailing.

Partial-pressure suiting is already standard equipment for Lightning pilots and the crews of some V-bombers in the RAF. The latest version, displayed by **Frankenstein,** is the jerkin with pressurized sleeves and gloves, the latter being also electrically heated in one instance. Anti-g trousers form part of the partial-pressure system as well as performing their main function. Worn with the clothing on the dummy displayed was a **Baxter, Woodhouse & Taylor** partial-pressure helmet. Forming an integral part of the suit were the flotation bags and inflation device of the Mae West; and the new **Ultra** 2A7 rescue beacon and battery were sewn onto the suit.

M.L. Aviation showed three advanced helmets, one of which, they stated, had an RAF stores reference number and was standard equipment in service. This was the partial-pressure helmet with automatic visor, made in three basic sizes and then modified in stores to fit an individual pilot. The helmet shown was for "Spud" Murphy of Handley Page. The whole helmet can be quickly discarded after pulling a knob located near the right ear. A picture on the M.L. stand showed their new full-pressure helmet, about which no details could be given. Final exhibit was a new aircrew crash-helmet assembly incorporating a stout blast visor which would drop down to protect the upper portion of the man's face under the g-load imposed by ejection. Beneath the blast visor was an independent sun visor. The plastics shell of the helmet, which appeared larger and stronger than the existing standard model, had been made by **Helmets Ltd.**

Three companies are co-operating with the **Institute of Aviation Medicine** in the development of a standard full-pressure suit for the Services. **Siebe Gorman** were exhibiting a thick fabric suit with soft head-piece having a Melanite (sheet Terylene) face-piece which seemed to crumple happily as the head-piece was folded into the open position. The Melanite is flattened against the face by blast forces during ejection and forms a protective skin. The head-piece is large enough to allow the man to wear a standard protective helmet under it. Mobility at elbow, shoulder and knee is provided by tailored folds supported by webbing pulleys. Freedom of movement when the suit was inflated appeared remarkably good. Pressures of between 1½ and 2½ lb/sq in seem to be standard and the relief valve on the left thigh of the suit can be adjusted to a chosen setting. It will then maintain the selected pressure regardless of the volume of air passing through the suit. The standard bale-out oxygen bottle can pressurize the suit effectively as the man ejects.

A small number of these full-pressure suits are now being produced, but both Frankenstein and Baxter, Woodhouse & Taylor exhibited their own versions. Frankenstein showed a dummy wearing a silvered version providing heat insulation and carrying a **Normalair** liquid-oxygen pack on his back. A moon-like background was formed from foamed plastic. Baxter, Woodhouse & Taylor showed their Windak suit and gave live demonstrations. This suit differs from the others in having sealed ball-bearing swivel-joints at shoulder, elbow and wrist. It is also provided with chest and waist harnesses of ribbed plastic to provide some support to the suit. The full-pressure helmet was tensioned down by a quick-adjusting harness running between the legs. With the suit inflated to 2½lb/sq in, the subject was able to reach the ejection handle above his head with apparent freedom. A ball-joint and flexible neck section allowed him surprising freedom to nod or rotate his head. The oxygen supply was applied at the back of the helmet, decreasing the bowing load on the head. The helmet visor had electric filament heaters to prevent misting.

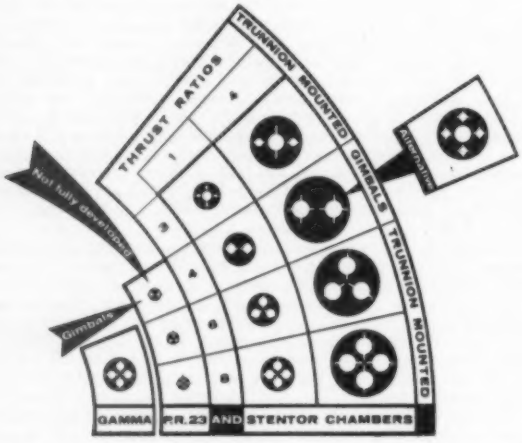
R.F.D. and **Walter Kidde** have now finalized their automatic one-man dinghy system by which the dinghy will inflate round the subject and float him clear of the water in some 30sec. The dinghy unfolds automatically out of its pack and is positioned by a small-bore tube which inflates and spreads the dinghy in the water underneath the man. Tests have shown that the system works effectively however the man is floating in the water. In one instance a test subject jumped into a swimming pool with a lighted cigarette in his mouth. His Mae West supported him until the dinghy lifted him clear of the water without his cigarette being extinguished.

ROUND THE STANDS . . .

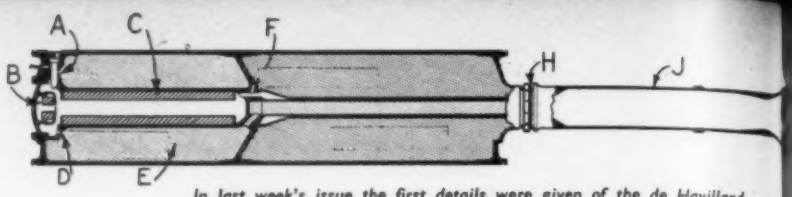
Propulsion

IN last week's issue we reported upon most of the major new developments in gas turbines, and upon VTOL propulsion in particular. Yet there is at least as much to say about the development of powerplants for relatively low and very high flight speeds —namely, piston engines and rocket motors. In the former field the pre-eminent names are Alvis and Rolls-Royce, the latter company having undertaken to manufacture light horizontally opposed units designed by the US Continental Motors Corporation.

Outwardly, there is seldom very much to report upon the aero-engine work of **Alvis Ltd**, and this year the only exhibit that could really be discussed in detail is a superbly sectioned Leonides 531. But behind the scenes both the single-row Leonides and the double-row Leonides Major continue to fulfil arduous requirements under every conceivable type of operating condition. Probably the most severe duty of all is the propulsion of ASW helicopters, in which very high powers must be sustained for hours at a time during dunking duties, with the helicopter hovering at 50ft or below. The salt-water environment, lack of forward speed and absence of substantial angular momentum in the output (so that any loss of power is likely to be very serious, if not catastrophic) are most difficult to match with the demands for extreme reliability and maximum overhaul life.



The diagram above suggests some of the possible ways in which existing Bristol Siddeley rocket chambers might be disposed in order to provide a wide range of powerplants with thrusts ranging from 50 up to 100,000lb. Chamber hinge axes are indicated



In last week's issue the first details were given of the de Havilland Spartan I pre-packaged liquid rocket, developed under a technical agreement with Thiokol Chemical Corporation. The sketch above shows its simplicity: A, igniter; B, booster charge; C, pressurizing cartridge; D, burst band; E, fuel (amines); F, oxidant (nitric acid); H, area in which propellants mix and ignite hypergolically; J, combustion chamber

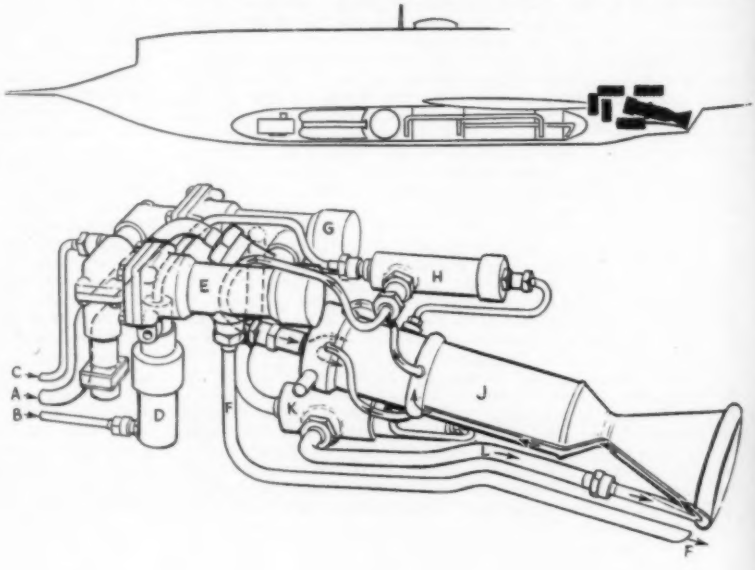
Principal helicopter engine is the Leonides Major 755, with a maximum continuous rating of 695 b.h.p. For the difficult ASW mission in the Royal Navy's Whirlwind HAS.7 this engine is at present pulled every 300hr; elsewhere the same installation is currently overhauled on a 600hr basis. Whirlwinds powered by this engine are in wide service outside the UK, and both the helicopter and its powerplant are made abroad under licence.

Alvis feel that the long-stroke Leonides 531 single-row engine has been sold with surprisingly little effort, particularly to both the Ministry of Aviation and existing owners of Twin Pioneer aircraft, for conversion of those machines originally built with the lower-powered Leonides 514. Overhaul life of the Mk 531 engine is at present of the order of 600hr. It is difficult for this to be rapidly extended, in view of the relatively low aircraft utilization; but it is anticipated that the ARB will not have to see very many units before the life can be increased at least to the levels reached by earlier Leonides.

Incidentally, Alvis remain an entirely independent company, reflecting the character of their managing director. Rumours concerning possible take-overs or mergers have been prolific during the past year, but do not at present appear to have much foundation. Roughly 45 per cent of the firm's business is aeronautical, and this includes substantial sub-contract production of high-precision machined parts for gas turbines by Rolls-Royce and Blackburn Engines. Most of the components are steel shafts and gears, but one contract covers all aluminium-alloy castings for the Blackburn Nimbus.

The only other engine company suffering under the strains of ASW dunking is **Napier Aero Engines Ltd**, whose Gazelle 161 is in full Royal Navy service as the powerplant of the Westland Wessex HAS.1. This engine has a one-hour rating of 1,430 s.h.p., and more powerful versions (described in *Flight* for August 31) are under development for later marks of the same helicopter. Discussions with Naval personnel at Farnborough leave a clear impression of preference for turbines, on the grounds of reduced in-flight vibration and aircrew fatigue; and to some extent it may be reasonable to hope that the newer powerplants may lead to a reduction in the number of failures of various airborne systems.

Napier have had to take special precautions to fit the Wessex installation to the salt-water environment. It is not entirely fortuitous that the intake velocity of the Gazelle is relatively low, and this substantially reduces ingestion problems (not only of sea-water but also of sand and any other foreign material). As is generally the case with Napier gas turbines, the compressor rotor blades are of aluminium-bronze. This has good resistance to corrosion, but it is impossible to avoid progressive coating with salt and other matter, which is periodically removed by purging the engine with special cleaning fluid injected at the intake during



Bristol Siddeley's diminutive PR.37 rocket engine, with an inset above illustrating its installation in the Jindivik: A, HTP input; B, kerosine input; C, nitrogen input; D, kerosine stop valve (non-electric): E, HTP jettison valve; F, HTP jettison pipe; G, HTP stop valve; H, mixture-ratio trimming valve; J, thrust chamber with inner and outer walls fabricated from steel sheet; K, HTP control valve; L, HTP feed to annular space between chamber walls

NEW from Delaney Gallay

ALL METAL VIBRASHOCK ISOLATION

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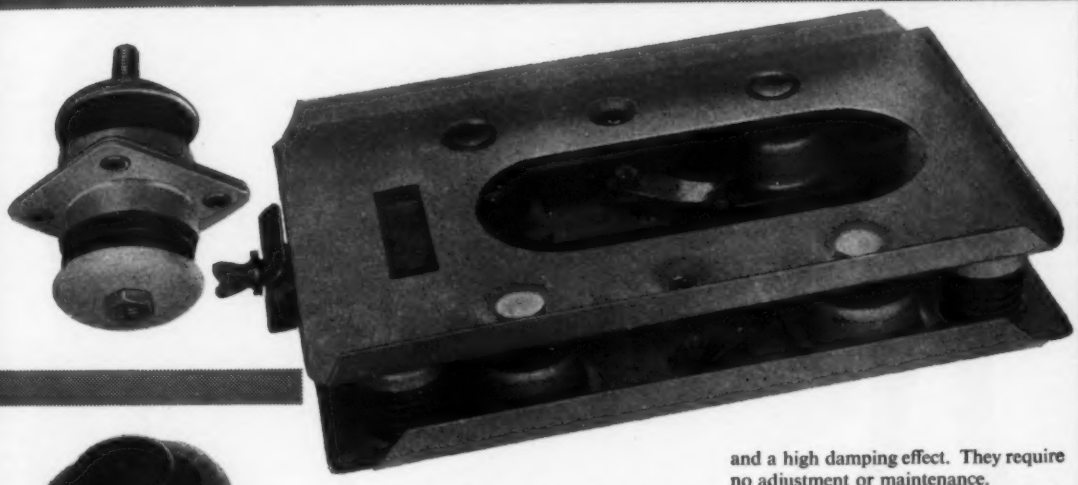

Delaney Gallay have now introduced a new and fully developed type of all-metal vibration control system, designed to protect delicate equipment from vibration and shock.

These units are small, lightweight and accommodate both aerial and radial motion. They have a wide load tolerance and a high damping effect. They require no adjustment or maintenance.

The basic principle of Vibrashock Isolation can be applied in an endless variety of ways to protect virtually any piece of equipment however mounted. We are actively engaged in engineering systems for the aircraft industry and shall be glad both to tell you about our work and discuss your needs.

Vibrashock Isolation units are available in standard sizes and types and data sheets can be supplied on request. We strongly recommend, however, that you should consult us at the earliest possible stage of your project so that we can design a complete system for the equipment you wish to protect, since it is only in this way that maximum advantage can be taken of Vibrashock Isolation's remarkable properties.

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NOW IT'S PYE LING

A NEW FORCE IN ENVIRONMENTAL ENGINEERING

Pye, one of the foremost names in British electronic engineering, has now consolidated the achievement of its subsidiary, W. Bryan Savage Ltd, and at the same time broadened the scope of its activities by bringing it into association with the great Ling Temco Vought Corporation of America to form a new Company, PYE-LING LIMITED. This organisation will produce a range of Vibration and Fatigue Testing equipment that will be unmatched throughout the world for comprehensiveness and quality. The resources and experience of both the Pye Group and Ling will ensure that the British Aircraft Industry will have immediately available the precise equipment it requires for the proving of every type of component.

The Liquid Cooled Vibrator illustrated has a Thrust Rating of 30,000 lb. and is the largest of a comprehensive range which starts at 25 lb.

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AP.13

One of the first photographs to be released of the Gamma 301 rocket engine, three of which are here seen being assembled by Bristol Siddeley's Rocket Division at Ansty. In the background is a Stentor, the small thrust chamber of which is employed in the new Gamma 301

ground-running. Special protection treatments are utilized on magnesium-alloy components, particularly fluoride anodizing, epoxy-resin impregnation and final coating with epoxy-based paints and clear epoxy resin.

Today the British firm making the broadest effort in the field of liquid-propellant rocket propulsion is **Bristol Siddeley Engines.** For 15 years this company and its predecessor Armstrong Siddeley Motors have supported major programmes of research, development and production into all kinds of units burning a variety of propellant combinations, and having fixed or gimballed chambers and fixed or variable thrust. In recent years the work has been concentrated upon HTP/kerosine engines fed by turbopump, and these have found very important research and military production applications.

Most advanced of the company's engines is the Stentor powerplant for the Avro Blue Steel Mk 1 stand-off bomb for RAF Bomber Command. This aerodynamic-cruise vehicle can be released "within a circle several hundred miles in diameter, the centre of which is the target" and it thereafter flies "at altitudes and velocities which defy interception" (these statements have only just been cleared for publication). For many months Stentor has been in quantity production at the company's Rocket Division at Ansty, near Coventry, and it recently completed the MoA Type Approval Test (a confirmatory test for similar tests completed "over the previous few years").

The large and small thrust chambers are both pump-fed with HTP and kerosine, which although having only modest specific impulse is considered an ideal combination for such a weapon (as discussed in *Flight* for June 1). After leaving the factory the engine is not fired again until the missile is on its way to the target. This demands extreme reliability, and flight experience to date indicates that such reliability has been achieved. Moreover, each Blue Steel is held at instant readiness with its tanks filled with propellants, which are drained and refilled once per month during stand-by.

Bristol Siddeley are permitted to emphasize the precision with which the thrust and mixture-ratio of Stentor may be controlled. In order to reap the maximum reward from this outstanding powerplant, many of its components—obviously including the smaller of the two thrust chambers—have been used as a basis for an improved version of the Gamma engine which powers the Black Knight ballistic research vehicle. It will be recalled that the earlier Gamma 201 achieved an enviable record of reliability, all ten launchings of the Black Knight to date having been successful. The new engine, designated Gamma 301, employs four chambers each pivoted about a radial gimbal-axis; and, from its appearance, it seems to be the powerplant of the hypothetical second-stage satellite launcher which the RAE suggested could be mounted atop Blue Streak rather more than a year ago. Now, however, Gamma 301 is matched to an "improved Black Knight," and is accordingly in receipt of an MoA development contract. The engine is not only more precise in operation than Gamma 201 but also has a longer rated life, is simpler to prepare before firing and utilizes its propellants more efficiently.

One of the smallest liquid-propellant rocket engines in the world is the PR.37, of which a *Flight* artist has prepared a sketch. Although its design has been carried out with a variety of applications in mind, it has been sponsored by the MoA as a booster unit to enable the latest mark of Jindivik target to reach an altitude of 65,000ft. In view of its application the PR.37 is at present tuned for operation at such altitudes, where it gives a thrust variable between 50lb and 170lb. Propellants are HTP and kerosine, which are stored in identical pods attached close together beneath the wing. The fluids are expelled by spheres of gaseous nitrogen at high pressure, and the sketch shows the basic operation of the thrust chamber. The complete Jindivik installation weighs about 120lb, not including 325lb of propellants. Since Jindivik is a pilotless target, means have had to be found for replacing components damaged during missions without extensive check firings; and another feature is the satisfactory cooling of the chamber at very low thrust levels.

Although the engines themselves are well enough known, it is appropriate to comment upon the three light and executive powerplants of Continental design exhibited by Rolls-Royce Ltd. This is the first time **Rolls-Royce Continental** units have been displayed in Britain, and each was, of course, manufactured in Muskegon by the US firm. The first model to go into production at the Light Aircraft Engine Department at Crewe is the O200A flat-four, rated at 100 h.p. and used in a wide range of British and (particularly) European light aircraft. Tooling up is proceeding rapidly, and production examples should appear in something less than a year. From the viewpoint of size, the second engine to be displayed at Farnborough was the 145 h.p. O300C flat-six, with a swept volume of 4.9 litres and weight of 277lb. This engine is also fast approaching production, and the geared GO300C, rated at 175 h.p., is flying in a Beagle Airedale. Most powerful of the engines so far designated for production at Crewe is another flat-six, the direct-injection GIO470A. Rated at 310 h.p., this beautiful piece of machinery weighs only 455lb and will be matched with a 7ft 6in McCauley propeller (to be made under licence by Dowty-Rotol) as the powerplant of the production Beagle B.206. The prototype of this aircraft is at present flying with US-built 260 h.p. IO470D engines, with direct drive to 7ft propellers. Largest of the range likely to be built in Britain is the GTSIO520, rated at 390 h.p., chosen by Short Bros for the Skyvan 1.

The three basic Bristol Siddeley rocket thrust chambers, which can be grouped as shown on the opposite page to meet thrust requirements from 50 to 100,000lb. The two largest chambers are used in the Stentor; the smaller of these is also employed in the Gamma 301, and the two miniature units are part of the PR.37

TRIPARTITE CONFERENCE

Delegates from the US, Canada and the UK Meet at the Royal Aeronautical Society

OVER 500 delegates from three aeronautical learned societies have been attending the 1961 conference at the Royal Aeronautical Society's new lecture theatre in London this week. Participating for the first time, in common with America's Institute of the Aerospace Sciences and the RAeS is the Canadian Aeronautical Institute.

As a preliminary to the SBAC Show, which almost all the delegates attended, there was a reception on September 3, and some *Flight* photographs taken on that occasion appear in these pages. Last Monday the four-day technical session began and summaries of the 15 papers are given below; we hope to accord more detailed treatment to certain of these in future issues.

Though not strictly a part of the conference, the 49th Wilbur Wright Memorial Lecture also took place, being given last Tuesday by Dr Abe Silverstein, Director of Space Flight Programs in the National Aeronautics and Space Administration. His subject was *Researches in Space Flight Technology*, and he showed how research methods evolved during over 50 years of manned flight have provided a foundation for rapid development of the new science. The lecture went on to review some of the current work on the aerodynamic propulsion, structural and environmental aspects of manned spaceflight. It is intended to report the paper in some detail in an early issue of *Flight*.

Meteorological Measurements from the Tiros Satellites, by W. G. STROUD (*Chief, Aeronomy and Meteorology Division, Manager Goddard Space Flight Center, NASA*) Two Tiros (Television-Infra-Red Observation Satellite) satellites have yielded an enormous quantity of information on the distribution of clouds and electromagnetic radiation over the surface of the Earth. The analysis and interpretation of the data are still in process. However, more than 35,000 television pictures of the Earth have been scanned and, where possible, nephanalyses prepared. More than 750 orbits of Tiros II radiation data are being converted to digital tapes for computer use and to radiation maps for visual inspection and analysis.

Both Tiros I, launched April 1, 1960, and Tiros II, launched November 23, 1960, were placed in nearly circular orbits at 400 n.m. altitude with inclinations of roughly 48°. In both cases, the orbit period was approximately 99min. Tiros I, which contained two television camera systems, one wide angle covering roughly 750 by 750 miles and a narrow angle covering roughly 70 by 70 miles, operated for 79 days, yielding 24,000 pictures, 16,000 of which were of sufficient quality and contained enough cloud information to be used for analyses. Square clouds associated with tornado activity, mountain clouds, desert features, the glinting of the sun on the sea, in addition to the unexpectedly large-scale organization of clouds, are all seen for the first time from satellite altitude.

The Tiros II was distinguished from Tiros I by the addition of a radiation-detecting system which, using the spin of the satellite to produce the scan line, mapped out the distribution of radiation in 6.3 micron (water vapour) region, the 8 to 12 micron window, the 7 to 30 thermal region, and two visual channels, 0.55 to 0.75 micron for comparison with the television, and the 0.2 to 6 micron (albedo) region. These data are acquired by the satellite in an independent data storage and telemetry system with some unique features and transmitted over an independent telemetry link. On the ground, the data are processed to produce digital magnetic tapes which can be handled by means of the IBM 7090 computer from which they can then be plotted out or printed out as desired for future analysis and study.

The Tiros satellites have demonstrated the potential of this modern tool for the exploration of meteorology on a global scale.

On the Attitude Control of Earth Satellites, by E. G. C. BURT (*Head of Dynamic Analysis Division, Guided Weapons Department, Royal Aircraft Establishment, Farnborough*) The paper discusses several possible methods for the attitude control of satellites, and distinguishes between active, passive and semi-passive systems. Active control refers to the usual concept of an error-actuated, feedback control system, where the attitude error (or some function of it) is sensed explicitly, and used to control a torque-producing device. This method, of general applicability, presents no particular difficulty in the field of control theory; the real problems arise in the design of physical elements which must operate in a weightless, airless environment.

For Earth-orientated satellites it appears possible to use passive or semi-passive methods, making use of a particular set of reference axes in which some of the torques acting on the vehicle (e.g., that due to the gravity gradient) have a stabilizing effect. Attitude control is then achieved merely by dissipating energy, and no sensing elements or feedback loops are required. Energy is removed by damping the relative motion between two different parts of the satellite; the passive system relies on moments of inertia differences to induce the relative motion, while in the semi-passive method this is augmented by introducing additional gyroscopic effects.

The possibilities of a fluid damping system are considered, and the semi-passive method is discussed in some detail. It is shown that, by suitably modifying the dynamic response, the effects of certain disturbing torques, such as that due to solar radiation pressure, can be greatly reduced.

The passive and semi-passive methods appear to hold considerable promise, particularly for those missions where the need for reliability and longevity is paramount.

Upper Atmosphere Experiments with Particular Reference to Black Knight and Skylark, by PROF SIR HARRIE MASSEY (*Quain Professor of Physics, University College, London*) For some years now the solid-fuel-propelled rocket Skylark has been used to transport equipment to altitudes of up to 200km for the study of upper atmosphere properties. The rockets have been launched at Woomera and the work has involved co-operation between British Universities (co-ordinated by the Royal Society), the Royal Aircraft Establishment and the Australian Weapons Research Establishment. An account will be given of some of the techniques used and the results obtained in a wide range of investigations. The value of high-altitude rockets, such as Black Knight, for testing equipment to be flown in satellites and for certain specific investigations will be discussed.

Air Marshal Sir Owen Jones, RAeS president, and Dr H. Guyford Stever, IAS president

Communications Satellites, by DR GEORGE E. MUELLER (*Vice-President for Space Systems Program Management*), WILLIAM B. HEBENSTREIT (*Director of Advanced Projects, Program and Planning and Development*) and EUGENE R. SPANGLER (*Staff Assistant in Space Systems Program Management, all of Space Technology Laboratories, Inc*) The major decisions affecting the establishment of wideband communications systems using satellites are discussed from the point of view of the optimum use of available and nearly available hardware and techniques to satisfy the forecasted requirements. Choices in the design of the communications relay system, in orbit selection, in temperature control, in ground-station design, and their bearing on each other, on cost, and on reliability are reviewed, and basic criteria are established. It is concluded that active relays in 24hr or 12hr circular orbits are likely to be the optimum choices.

Ground Proximity Effects Associated with V/STOL Aircraft, by JOHN P. CAMPBELL (*Aerospace Technologist, NASA Langley Research Center*) Various problems arising from operation of V/STOL aircraft close to the ground are discussed. All forms of ground proximity effects are covered, including effects of slipstream impingement and recirculation on the surface beneath the aircraft, on objects around the take-off and landing area, and on the aircraft itself. The characteristics of the slipstream are first discussed, and it is shown that there is a rather rapid decay of slipstream velocity following the vertical impingement of the slipstream on the surface.

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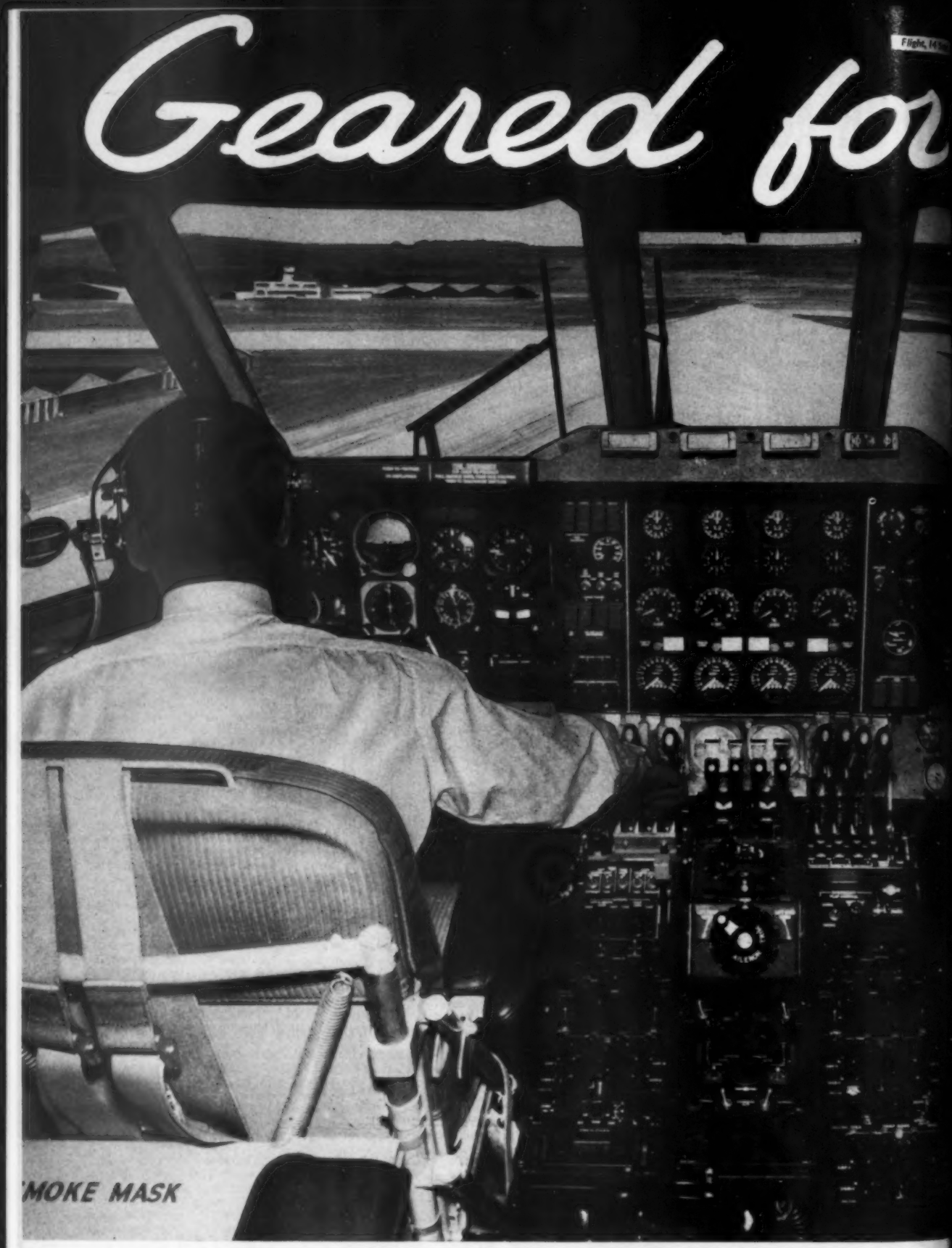

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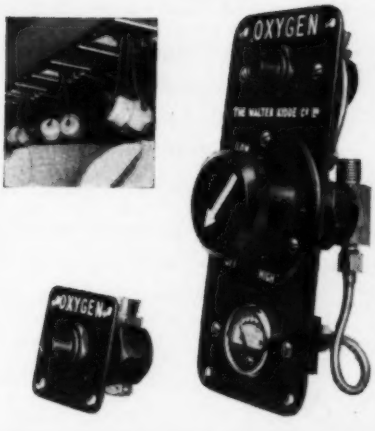

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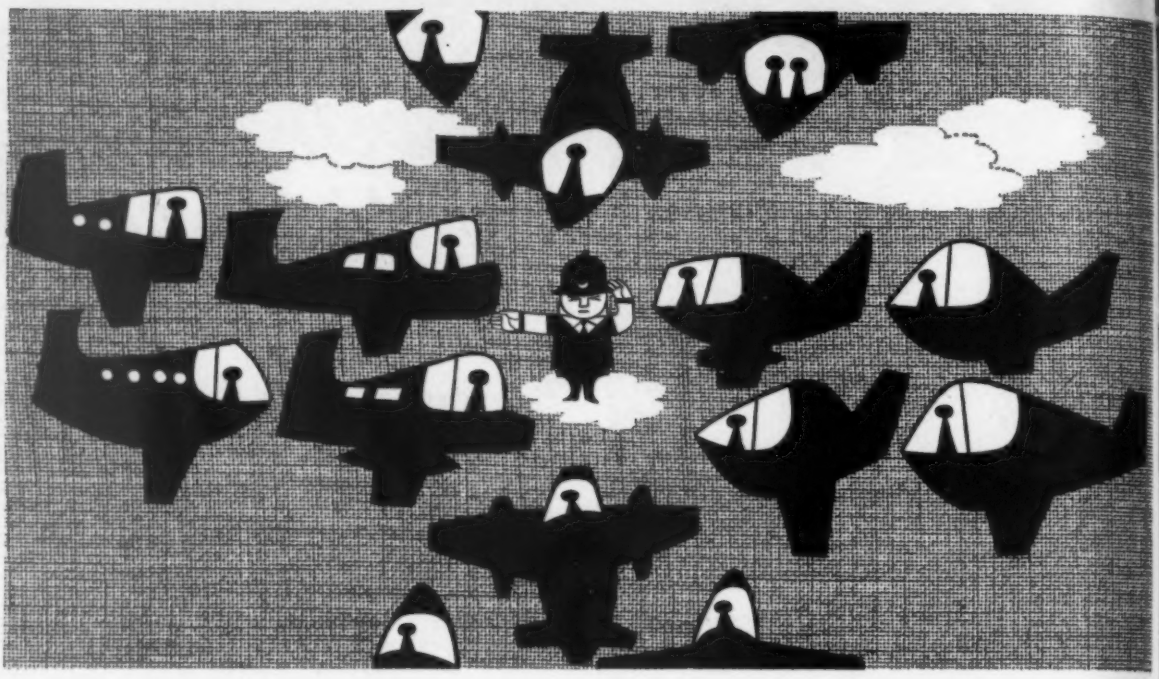

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TRIPARTITE CONFERENCE...

Surface erosion is shown to be dependent on the dynamic pressure of the outward flow of air along the surface and the type of surface involved. Although research has indicated some pertinent factors involved in the problems of surface erosion and recirculation of debris, experience with higher-performance V/STOL aircraft under operational conditions is required to determine to what extent the utility of the aircraft will be compromised by these problems.

It is shown that the tendency to slide or blow over objects around the take-off and landing area may actually be less for the higher performance types than for the helicopter because of the more rapid decay of the higher-velocity slipstreams and because of the thinner sheet of air flowing along the ground.

The effect of the ground on the hovering lift of various V/STOL aircraft types is discussed, and it is shown that the ground effect can be favourable, adverse, or negligible, depending upon the particular geometry of the aircraft and the location of the slipstreams with respect to the airframe. Research so far has also indicated that slipstream recirculation can have pronounced effects on the handling qualities of V/STOL aircraft flying near the ground.

Some Considerations in Selecting VTOL Propulsion Systems, by A. P. ADAMSON and D. COCHRAN (*General Electric Company, Flight Propulsion Laboratory Department*) This paper presents a review of the engine characteristics which must be considered in selecting the best engine for a VTOL aeroplane. Most attention is devoted to jet-lift, turbofan lift, and tip-turbine fan-lift engines suitable for high-speed aeroplanes. Comparisons between noise, exhaust temperature, exhaust velocity, engine weight, engine volume, and engine frontal area are given. Engine-out safety, aircraft control power provisions, and take-off to cruise power matching are discussed.

H. C. Luttman, CAI secretary, and C. H. E. Warren, head of General Supersonics Division, RAE Farnborough

A second part of the paper presents test data from the General Electric-US Air Force-US Army-NASA lift fan and diverter valve research programme, including diverter valve performance, fan inlet performance, model pitch moment data, fan acceleration thrust, fan lift, fan speed variation, and representative fan-lifted aeroplane configurations.

The Inverted Turbojet, by D. L. MORDELL (*Dean of the Faculty of Engineering*), F. W. EYRE (*Department of Mechanical Engineering*) and A. V. SREENATH (*Assistant Professor of the Department of I.C. Engineering, Indian Institute of Science, Bangalore, and attached to the Mechanical Engineering Department*), *all of McGill University.* The inverted turbojet, in which the usual sequence of components is changed to give the sequence intake-turbine-heat exchanger-compressor-combustion chamber-nozzle, has been analysed thermodynamically and its development problems and possible applications are discussed.

It appears that this engine, alone among the pure air-breathing engines, can provide useful thrust from standstill to at least a Mach number of 6, possibly higher in due time. While not as good, at a given speed, as various other air-breathing engines, its performance potential at high speeds is in fact quite good, and it has a unique advantage in offering the possibility of giving tremendous shaft power, at hypersonic speeds, at very high thermal efficiency.

Aerodynamic and Propulsion Considerations of Minimum-field Aircraft, by P. L. SUTCLIFFE and V. K. MERRICK (*Hawker Siddeley Aviation Ltd*) and A. R. HOWELL (*National Gas Turbine Establishment*) The main theme of the paper is a discussion of the broad aerodynamic and propulsion aspects of flight at the very low speeds that are necessary for performances within the meaning of "minimum field." It opens with a proposal for a universal classification of airfield distance which could remove much of the ambiguity of many comparisons now made under the general heading of V/STOL.

The paper is then divided into two parts: Part I discusses the possibility of generalizing the aerodynamic lift and drag requirements for flight at very low speeds and the influence of thrust deflection in this regime. This is followed by an investigation of airfield performance in the minimum-field category. The comparison between airfield performance requirements and the generalized aerodynamic requirements then leads to a relatively simple classification of the aircraft characteristics required for various degrees of V/STOL performance. Part I concludes with a brief discussion of the implications of controllability on engine thrust requirements when direct or indirect engine thrust is used to augment the normal aerodynamic controls.

Sir George Edwards, BAC executive director, and Robert L. Baer, P & W manager

Part II deals with the turbofan and turbojet configurations likely to be used for V/STOL applications. Particular attention is paid to the all-important question of engine weight. Some consideration is given to the illustration penalties and to the provision of the higher installed thrusts that are required to cover hot and high control and other conditions. General aspects of the noise problem are dealt with.

Transports of the Future—a Systems Approach, by GEORGE C. PRILL and HAROLD HOEKSTRA (*respectively, Director, Flight Standards Service, and Chief, Aeronautics Branch, Aviation Research and Development Service, Federal Aviation Agency*) The supersonic transport will probably be a part of the air transportation system of the next decade. A "system" approach similar to that used in the development of a weapons system is essential to ensure safety, reliability, and low operating costs. The characteristics of the supersonic transport must permit its blending into a mixed operation of subsonic passenger jets, cargo aircraft, and VTOL short-haul aircraft. The mistakes of the past must be studied and not repeated.

It is suggested that the traditional concept of airworthiness be broadened into a new concept of "systemworthiness." The supersonic transport must be systemworthy, and so must every other component of the system, if success is to be attained.

Maj G. P. Bulman, late hon treasurer of RAeS, with Dr Wright

In a systemworthiness concept, the sonic boom, airport noise, overall runway length and strength requirements, the air traffic system and other elements must be considered. Further, weather limitations must be completely overcome. The supersonic transport must be able to cope not only with the traditional enemies of icing

TRIPARTITE CONFERENCE...

and turbulence and the new enemy, kinetic heating, but also must be able to operate without regard to ceiling and visual minima. The paper suggests that automatic take-off and landing are necessary to provide schedule reliability.

Some of the problems and experiences encountered in the past in the introduction of new equipment into the aviation system are reviewed briefly and the present status of airports, the air traffic management system, and their probable future trends are outlined. Work on new developments such as automatic landing and anti-collision devices is described and some aspects of the present status of the supersonic transport, the Federal Aviation Agency development programme on the supersonic transport, and the status of airworthiness, operations, and maintenance standards are outlined.

B. S. Shenstone, BEA chief engineer; Capt J. L. Pritchard, late secretary of RAeS; and S. Paul Johnston, director, IAS

The Influence of Some Operational Problems on Supersonic Air Transport, by R. G. THORNE (*Senior Principal Scientific Officer in charge of the Human Engineering Division of the Mechanical Engineering Department, Royal Aircraft Establishment*) Since the aircraft industry is now moving from the preliminary assessment phase to a more practical stage in the development of supersonic transport aircraft, it will have to define with more precision the operational restrictions likely to be met in regular airline service. This paper discusses some of the many operational problems that have emerged during the past five years. It refers to the economics of operational restrictions and discusses air traffic control and airport problems. Noise aspects are touched on briefly. The implications of passengers and crew comfort and safety are considered. Since in future the systems engineer will play a larger part in the definition of the basic aircraft characteristics, the choice of auxiliary power systems is briefly reviewed.

The Supersonic Commercial Air Transport: Requirements and Problems, by JOHN STACK (*Assistant Director, Langley Research Center, NASA*) The requirements for a supersonic commercial air transport are reviewed from the viewpoint of defining the research areas in which technical and scientific information is needed.

Some recent work applicable to the solution of some of the technical problems is discussed. Some of the further research considered necessary to the accomplishment of an economically satisfactory supersonic commercial transport is suggested.

General Aspects of Supersonic Transport Aircraft, by A. E. RUSSELL (*Director and Chief Engineer, Bristol Aircraft Ltd*) General problems involved in the development of supersonic transports have received the widespread attention of all major technical organizations connected with aeronautics. One of the most controversial issues has been whether such aircraft should be designed to operate at cruise speeds around M2 or around M3. The two conceptions differ radically in all major aspects. While the former poses many new and complex problems, the advance in techniques required can be regarded as a typical step in the history of aviation. The latter, however, mainly on account of the much greater rise in prevailing temperatures, demands novel departures from present civil practices in almost all features of the engine, airframe and its systems.

The choice between the two speed regimes is a question of technical judgment, and the issue of facing additional engineering risks and balancing these against small operational advantages. A brief outline is given of the basis for preferred alternative aerodynamic arrangements. In particular, it is shown that the slender delta, while being the optimum shape for M2, is less suitable than the canard delta for M3. The inherent temperature effects control the choice of materials for the structure, thus emphasizing the dissimilarity of the two solutions.

The design and development of the aircraft primary systems are also strongly influenced by their relevant temperature conditions. In particular, improved fuel qualities are likely to be necessary at the higher speed. The greater heat input into the aircraft also reduces the relative effective use of the fuel as a heat sink.

The more onerous conditions and the greater demands on the systems lead to an increase in their complexity and installed weight by comparison with current designs.

Finally, an attempt is made to estimate comparative aircraft selling prices and to assess the effect of this on operating costs.

Aerofoil Characteristics with a Sink Located in the Upper Surface, including Comparison of Theory with Some Fan-in-Wing Experiments, by D. C. WHITTLEY and J. R. BISSELL (*Avro Aircraft Ltd*) In recent years some consideration has been given to powered-lift systems in which air flow enters through the upper surface of the wing as, for example, for a VTOL fan-in-wing design. One problem common to such designs is the large nose-up moment associated with the fan-wing combination. Theoretical and experimental analyses are described which investigate the nature of this problem.

Consideration is first given to a potential flow solution for a two-dimensional flat plate aerofoil with a line sink located in the upper surface. The effect of forward speed on the surface pressures is to reduce them ahead of the sink and to increase them by a corresponding amount behind the sink, such that the overall change in lift is zero, but a large nose-up moment is generated. Figures are given which suggest that the momentum flow which enters the surface has an effective moment arm of half the chord.

Consideration is also given to the effect of finite slot width, effect of wing thickness and shape of surface pressure distributions.

Influence of the inlet flow alone cannot be inferred directly from existing experimental results because it is not usual to have an inlet flow without a corresponding jet flow. Methods of analysis are described which enable the in-flow effects to be isolated from the jet effects.

Experimental results are shown to agree quite well with theory. Some design implications of the large nose-up moment due to in-flow are also briefly discussed.

E. A. Sperry, formerly vice-president and treasurer, Sperry Products Inc. and Dr T. P. Wright, Cornell Aeronautical Laboratory chairman

Looking Ahead in V/STOL, by GEORGE S. SCHAIRER (*Vice-President, Research and Development, Boeing Company*) This paper starts with a review of the propulsion and lifting characteristics of the various systems used on V/STOL aircraft. Fundamental limitations and growth possibilities are examined. The relationship between wings, power systems and stalling speed are presented and extended to cover take-off and landing distances. A comparison is made of the performance characteristics of several V/STOL types. The basic problems of V/STOL types are compared. The paper concludes with a forecast of future developments in V/STOL aircraft.

Control of VTOL Aircraft, by J. J. FOODY (*Short Bros & Harland Ltd*) The principles involved in the control of VTOL aircraft in the transition speed range, i.e., below the speed at which airborne flight can be sustained, are outlined, bringing out the philosophy behind the multiple lane approach employed by Short Bros & Harland. The principles of the SC.1 system are fully described, including comments on its efficiency as an electrical signalled system, and an account is given of flying experience up to the present time. Developments towards the goal of all-weather operation are described and comments made on further work that appears necessary to capitalize on the inherent safety of VTOL type landing in conditions of zero and poor visibility.

The monument at Kitty Hawk, North Carolina, which commemorates the first powered flight. The Wright brothers' achievement, incidentally, is also commemorated in other ways—for instance by the annual Wilbur Wright Memorial Lecture, which (as noted on page 442) was held in London this week

Visiting Kitty Hawk

BY BOB WHITTIER

THOUGH the Russians would probably dispute the matter (and, indeed, have done so) most people agree that the first powered flight was made by the Wright brothers, at Kitty Hawk, North Carolina, on December 17, 1903.

Yet, out of all the hundreds of thousands of men (and women) who have been interested in aviation since then, how many have actually made a pilgrimage to the birthplace of flight? Not very many! And, after twenty-five years of aviation interest, I too was among those who had never visited aviation's Mecca.

But recently I made a motor trip from Florida to Massachusetts, during which a gremlin kept jumping up and down on my shoulder and chattering excitedly about the obvious fact that it would not take very long to detour off the main north-south highway for a visit to Kitty Hawk. I had seen many a photograph of the chunky-looking tower atop Kill Devil Hill, but beyond that I could tell you nothing of the appearance and flavour of that Cradle of Aviation. The gremlin won the contest of wills.

We turned off Highway US 17 at a small community bearing the name of Washington, North Carolina, and headed in a general north-easterly direction. Of course my gremlin had seen to it that I had not noticed some small mileage figures on the road map, and only after we had been a good distance along this detour did I chance to notice that it was 150 miles to Manteo, beyond which lay Kitty Hawk!

So we drove and drove, and drove some more, first through flat farming country with tumbledown, weatherbeaten, unpainted old houses and barns sitting lonesomely in vast fields. Then dry upland ended and we found ourselves rolling along through desolate swamp country, with drainage canals running alongside the road for miles and nothing but tall dry grass and stark, dead cedars from horizon to horizon.

Through the hamlets of New Holland, Engelhard and Manns Harbor we went, and finally, feeling like Balboa discovering the Pacific, we saw the light brown, muddy waters of Currituck Sound. You think of sea water as being blue, but not so with this nearly landlocked part of the Atlantic! A very long wooden bridge crosses over it and takes one to low-lying Roanoke Island, a marshy country inhabited mostly by commercial fishermen.

Then you leave Roanoke over another wooden bridge and presently are on a windswept and sandy sea-coast island almost completely covered with a hodge-podge of weatherbeaten and wide-porched old summer cottages, in between which have sprung up starkly modernistic newer ones in faded and monotonous blue and pink. Sidewalk food-vending stands completed the tawdry look. This was Manteo. Driving northwards on the single main road we could catch occasional glimpses of the whitecapped sea to the east, and to the north a rather prominent, moundlike hill on top of which a grey-white tower stood out against blue sky. You forget the mundane sights on each side of the road as you drive north on this coastal road.

Why, you wonder more and more, did Orville and Wilbur Wright choose this utterly remote area for their glider experiments? Indeed, how could those two young men from the far-away Midwest even know about such a place as this sixty years ago, when there were no automobiles, no paved highways and even no bridges over the wide sounds? The answer, of course, is in the history books; when they first began to experiment seriously with gliders in 1900 they felt that a locality characterized by steady strong winds would be desirable. Therefore they wrote to the United States Weather Bureau asking for suggestions. Of the several windy places mentioned by that agency, Kitty Hawk simply happened to be nearest to their home in Dayton, Ohio—even though in those days it was even more inaccessible. The nearest railroad station was at Elizabeth City, many miles to the northwest across Albemarle Sound. Once a week a small sailing boat travelled to Kitty Hawk, then a hamlet consisting of just a score of widely scattered houses. Even today a swift motor trip across the lonely swamp country leaves one with a deep feeling that Kitty Hawk must have been the most improbable of all places in which to launch the air age!

As the car drew closer to the hill we came to a road on the left of the north-south coastal highway. It runs in a westerly direction, and in a few minutes we were on a circular road which goes completely around the base of Kill Devil Hill. A long, winding path ascends the east side of the hill, and we parked the car and made our way up it. As we reached the upper section we

The Wright brothers' living quarters at Kitty Hawk have been reconstructed in detail for posterity. Here is the interior

VISITING KITTY HAWK...

found ourselves on a large, star-shaped terrace paved with cobblestones.

We stopped to look around. Half a mile or more to the east was the sea vista of white breakers at the edge of the broad and blue Atlantic. Along the coastline there stretches a long line of summer homes facing the highway. To the distant south and west are hills and sand dunes, together with stretches of landlocked water. To the north of the island lies a dim, wooded horizon.

Then, looking north, we saw something that made us blink. Grey and lonely at the edge of a large field were two weather-beaten shacks, vaguely resembling airplane hangars. . Yes, the National Park Service has reconstructed in painstaking detail the original Wright camp of 1903! And nearby is a new museum building. The Memorial Shaft has become so much the focal centre of this famous area that the general Press has concentrated on it—and so most aviation enthusiasts do not even realize how carefully the Birthplace of Flight has been preserved.

And now, looking at the actual Memorial Shaft from its base, we see something that seldom shows up in panoramic photographs —a handsome metal door in the tower's base. From a distance, and in photographs, the tower looks as if it might be made of solid granite. But it isn't. It is hollow, and when we stepped through the door we found ourselves in a small but dignified lobby. A courteous Park Service attendant in olive-coloured uniform greets visitors and asks them to sign the guest register. Descriptive pamphlets are given to each visitor, and there are postcards and books on display.

A spiral staircase winds up inside the shaft, so we started up. Everything inside the shaftway is painted a utilitarian silver. Half way up there is a rotunda, in the centre of which is a handsome metal plaque showing the world and all the famous long-distance flights made from 1903 to 1928. It is quite amazing to be reminded of the great strides flying men made in twenty-five years; the map is almost completely criss-crossed by lines indicating the routes of many flights across continents and oceans. One's feeling of respect for the pioneering airman's courage and initiative deepens immensely.

At the top of the stairs a small door opens onto a rather small observation balcony just below the beacon atop the sixty-foot tower. Before our eyes lay the northern slope of Kill Devil Hill, on which over 1,000 gliding flights were made prior to the development of the power-driven airplane. In 1903 nothing but a dune of shifting sand, the hill has been safely and permanently anchored by the planting of special grass and shrubs. Perhaps a third of a mile north of the tower huddle the two wooden sheds and, having taken in the view from the observation balcony, we were eager to see them at first hand.

A winding road leads up to the reconstructed 1903 camp and at once you see something else which escapes attention in most photographs—a series of stones marking the actual site of the historic first flights of December 17, 1903. Set on a small earthen mound is one large boulder bearing a bronze tablet. From the edges of the mound project crude wooden rails, capped with strap iron. This is the actual starting point of the first flights and as we looked at the rails we experienced a very real thrill, for we were standing exactly where Orville and Wilbur Wright set up their "Flyer" and catapulted it into the air.

This boulder and its tablet were erected in 1929 by the National Aeronautic Association. And in a straight line marching north from it are four numbered tablets showing where each of the December 17 flights ended. The first is a scant 120ft from the boulder, or about as far as a Piper Cub might bounce in a poor landing. The other three are 195, 200 and 852ft away and convince one that the frail biplane really accomplished the miracle of flight.

Then we took a close look at the reconstructed sheds. One, closest to the boulder and starting track, is the hangar building. Long and narrow, its ends are hinged at the top so that they would swing up and allow the aircraft to be pushed out of either end on its launching carriage. Made of rough, weatherbeaten and irregularly-overlapped boards, the shed has a ground-level wooden floor. The roof is covered with tarpaper, and from its ridgepole projects a rod supporting a simple, vane-like wind direction indicator. Iron hinges on the doors are rusty and, all-in-all, one senses the kind of rustic and Spartan atmosphere in which great individual accomplishments seem often to be born.

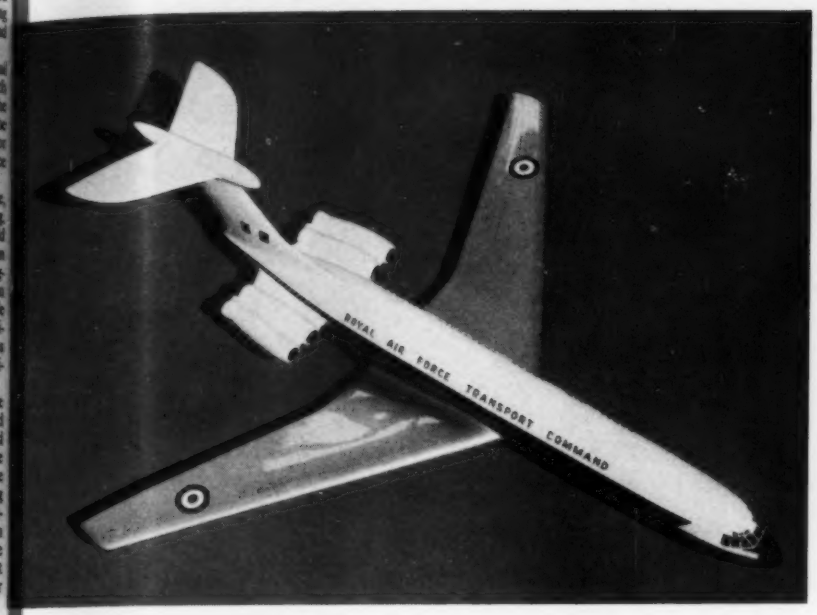
Behind the hangar an iron water pump has been driven into the ground. It reminds one that people lived and worked here, and prepares one for the other building, marking the Wrights' combined living quarters and workshop. At the southern end of this crude shed are simple, camp-like living quarters. A rough table at one side holds a few books and papers. On the other side is a heating stove fashioned from a carbide can, a kerosine stove of the sheet-metal, mail-order type, and simple but neat shelves of common board for tableware and provisions. One's eye wanders up to the open rafters and the beds become apparent—they are nothing but hammocks made of pieces of old rug nailed between beams up near the roof boards!

A short distance east of the wooden sheds is a new building which is a combination museum and administration office. It houses a duplicate of the 1902 glider and parts of the original biplane and its engine. A duplicate of the actual powered aircraft was under construction and was shortly due to join the display, along with an increasing quantity of photographs, original Wright tools and similar mementoes. The National Park Service hopes in time to be able to make a light-aircraft flight strip on some of the vacant land within the reservation, for the nearest airport at present is several miles south at Manteo.

Well, that was it. We had a much better idea of the present-day appearance of aviation's birthplace. Under the conscientious guardianship of the National Park Service, Kill Devil Hill and the First Flight Grounds are being protected, preserved and improved. It is a good thing, for obviously the whole historic area might have been built over with summer cottages and obliterated.

Leaving Kitty Hawk, we drove a tedious 75 miles north-west to Norfolk, Va, crossing another long wooden bridge over Albemarle Sound at one of its narrower points and traversing miles of flat, open farmland. Once again the remoteness and utter incongruity of Kitty Hawk as a work-site for a pair of unknown experimenters was impressed upon us. But we had seen tangible proof that Orville and Wilbur Wright really did travel to that lonely seacoast hamlet to work their miracle!

This ten-ton granite boulder, erected by the National Aeronautical Association in 1928, marks the take-off point of the epoch-making flights of December 17, 1903



Shape of things to come in RAF Transport Command: a model of the Vickers VC10 in the command's markings. An order for five of these aircraft for the RAF was announced last week. (See "RAF VC10s," this page)

SERVICE AVIATION

Air Force, Naval and Army Flying News

Air Chief Marshal Constantine

LAST week the Air Ministry announced the promotion of Air Marshal Sir Hugh Constantine, KBE, CBE, DSO, to Air Chief Marshal with effect from September 1. He is to be Commandant of the Imperial Defence College from September 25 (*Flight*, June 8), having been AOC-in-C Flying Training Command since March 1959.

Air Chief Marshal Constantine served with Bomber Command throughout the war. One of his post-war appointments was that of Deputy Chief of Staff (Plans and Policy) at SHAPE for two years. Before going to SHAPE in 1956 he had been AOC No 25 Group, Flying Training Command.

RAF VC10s

WORDING of the official MoA announcement about the VC10 order for the RAF said that "following a review of the Royal Air Force's requirements for strategic transport aircraft, it has been decided in principle to order five VC10 aircraft for use by RAF Transport Command. Discussions with a view to the placing of the contract are now taking place with the British Aircraft Corporation."

When Mr Geoffrey Rippon, the MoA Parliamentary Secretary, visited the SBAC Show on Tuesday last week, he said of the order: "I am delighted that this is going through. It is a very important decision on the part of the Government. It reflects our confidence in this aircraft."

Delivery of the VC10s for the Transport Command is expected about 1965; value of the order is in the region of £10m. The aircraft, it is understood, will be the standard version though with some differences in cockpit layout.

RN Wasps

WASPS (P.531) helicopters are going into service with the Royal Navy, primarily in the anti-submarine weapon-carrying role. An order for these aircraft, designed by the Saunders-Roe division of Westland Aircraft, was announced last week; it has been placed by the MoA on behalf of the Admiralty. Wasps will be based on the flight decks of frigates equipped with long-range asdic; by their ability to attack submarines at greater ranges than hitherto, they will confer a significant improvement on the Fleet's anti-submarine capability. They are also to be employed in a variety of subsidiary roles, including SAR and training.

Benevolent Fund's 21st

IN a letter calling for special support for the RAF Benevolent Fund in its 21st year, the chairman, Viscount Knollys, points out that this summer the Fund passed the £10m mark for all forms of assistance since its foundation in 1919. "Since the end of the war," he says, "expenditure has averaged £580,000 a year and during the past 13 years outgoings have outstripped money coming in by £472,331. That would be serious enough," he adds, "if the job were almost done but, in fact, the testing time is still ahead—in the 1980s when the large body of those who served in 1939-45 and the widows will be facing problems of old age and perhaps for the first time will need help."

A concert is being held in London next month, attended by Queen Elizabeth the Queen Mother, in honour of the 21st anniversary of the Battle of Britain. Viscount Knollys says that though most of the people of Britain cannot join in these London musical celebrations, they can make 1961 a splendid 21st birthday for the Fund by giving "birthday presents"—which, through the Fund, will go to those who most need it. "All contributions," he says, "will be gratefully acknowledged from the Fund's headquarters, 67 Portland Place, London W1."

IN BRIEF

The RAAF is to spend £370,000 on twenty-one new 2,500gal refuelling tankers.

The new AOC-in-C Flying Training Command, Air Marshal G. A. Walker, is to be among the guests at the RAF Flying College autumn ball on Friday, October 6.

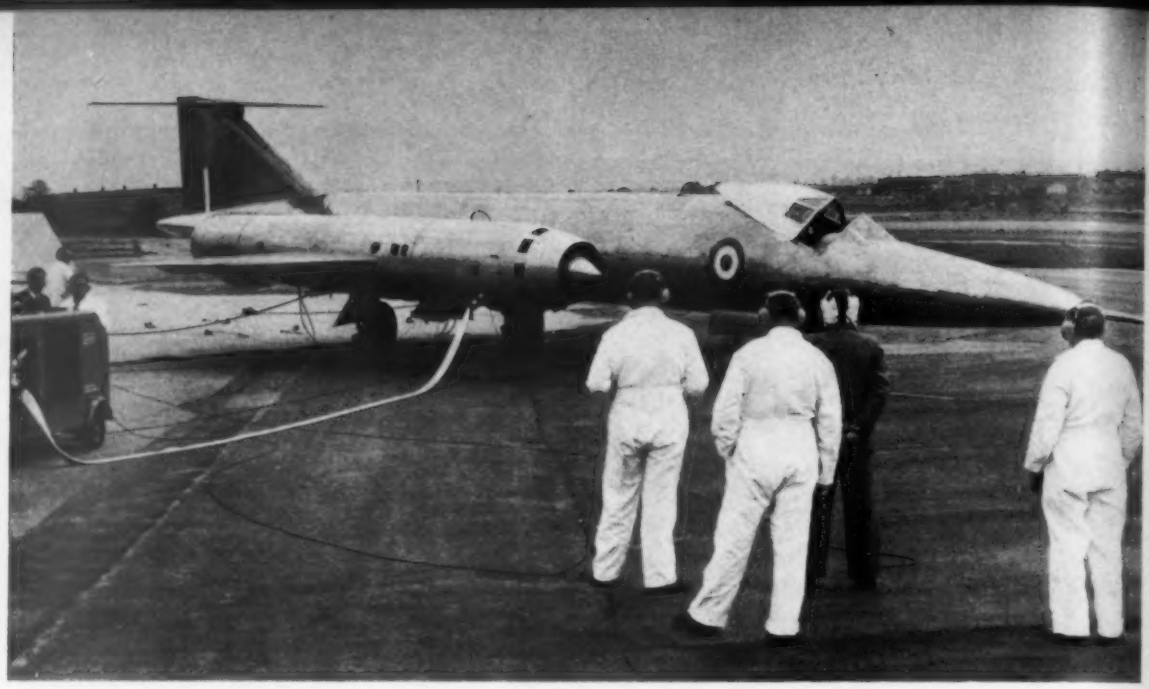
Three D.H. Doves ordered for the Royal Malayan Air Force were handed over at Hatfield on September 6. They left for their home base, Kuala Lumpur, under the command of Gp Capt J. N. Stacey, who commands the Royal Malayan Air Force.

The eighth 55 Sqn annual reunion is being held at the "Peacock," 14 Maiden Lane, Covent Garden, London WC2, on Saturday, October 21, at 6.30 p.m. Tickets (7s 6d) and further details from the hon secretary, Ivor Calverley, 38 Pondfield Crescent, St Albans, Herts.

Conventional time clocks are to be replaced at all major RAAF bases with direct-reading clocks, presenting the time in hours and minutes. The Minister for Air, Senator Harrie Wade, said this change would cost about £3,000. It was designed to streamline operations of air traffic control, operating units and SAGW units.

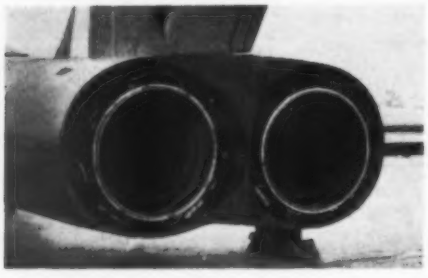
More than 4,000 soldiers and airmen are taking part this week in a land-air warfare exercise, code-named "Stagger," on Salisbury Plain. RAF participation includes Hunters of 165 Wing, Beverleys from Abingdon, Hastings from Colerne, and Pioneers, Whirlwinds and a Belvedere from Odiham. The Army Air Corps is represented by helicopters and fixed-wing aircraft of 6 Flight, Middle Wallop.

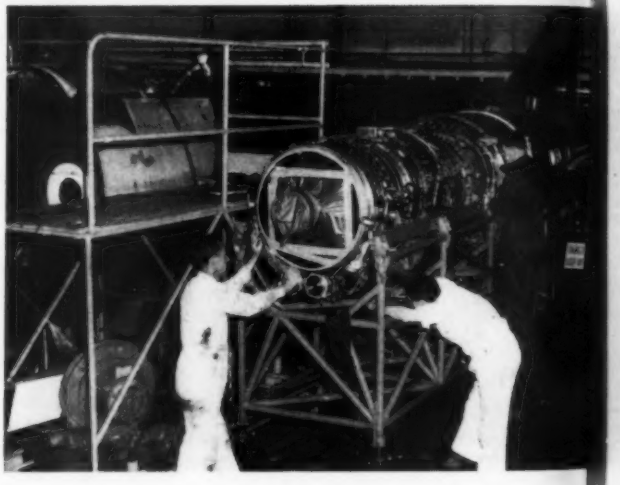
Four pilots at RAF Upwood who have been giving flying experience to ATC cadets at the station for summer camp during the past seven weeks. Left to right, Fg Off J. F. Larcombe of 35 Sqn; Flt Lt P. Butler, a Valiant tanker pilot at Marham; Flt Lt L. W. Collingridge, of Upwood; and Flt Lt W. A. Whiteford, of Brampton

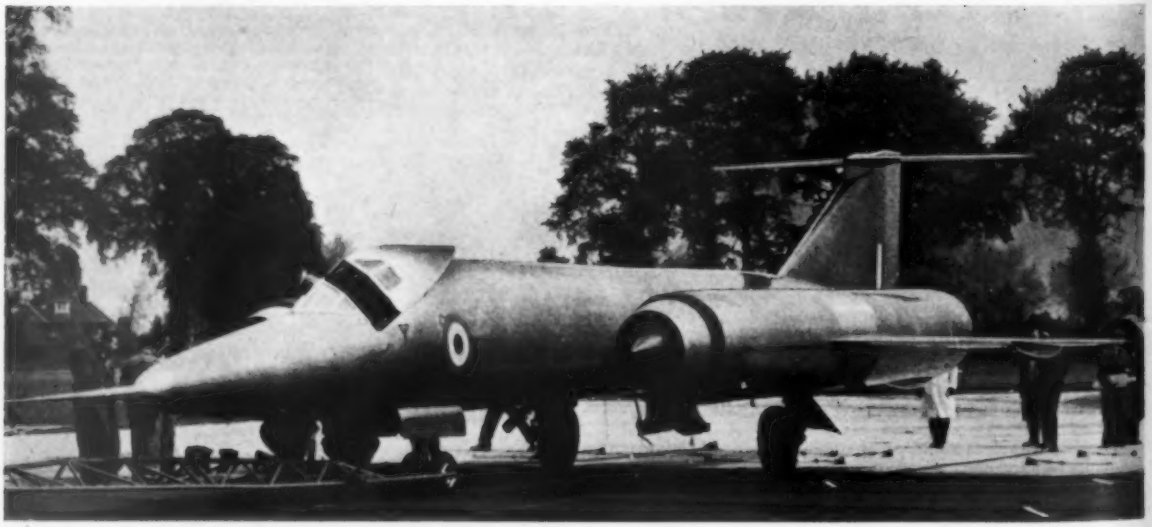


TYPE 188

The new pictures of the Bristol Type 188 supersonic research aircraft above, right and below show, respectively, ground-testing of the de Havilland Gyron Junior DGJ.10 reheated turbojets, installation of one of these units, and preparations for ground tests. The close-up shows the adjustable nozzles of development Gyron Juniors installed in a modified Gloster Javelin







Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Charging for Services

YOUR leading article, "A new tax on the airlines" (August 10), contains a passage which deserves further comment. The airlines may well ask why they should pay for a Tiger Moth to be given a weather forecast, or helped with a flight plan; but, as you rightly point out, such a question would be an affront to the facts. However, now that the Government is at long last waking up to this question of aviation subsidy, there are certain vital aspects which must be borne in mind, for instance:—

(1) If the private flyer will be required to pay his equal share of the cost of technical services, etc (and why not, indeed), then the Government will be bound to ensure that he has equal rights in the air and on the ground. This principle is one which successive governments have consistently refused to accept in the past.

(2) If all air users are going to have to pay their fair share, then *all* air users are entitled to a say in how the pattern of development of civil aviation should take place. At the moment the pace is dictated by commercial airlines. They cannot be blamed for this, and they are able to introduce equipment almost regardless of the consequences on other air users, the technical services, let alone the poor devils who live around the airports. No one wants to hinder progress, and progress may be dictated by trading or defence considerations—that's another matter, but no single air user should be able to dominate the airspace; it's not allowed at sea, nor on the roads.

(3) Economic sanity in the air will be a welcome change for this country, but remember, this does not automatically mean total sanity. If airports are to pay their way together with technical services, it's no use subsidizing aircraft development costs and constantly forcing new machinery into a market which cannot afford it. This will be particularly true of the private aviation market, whether it is termed private aviation, personal aviation, business aviation, general aviation, or anything else, and the movement will have to pay careful attention to any attempt to obtain subsidy unless its purpose has been made public.

(4) As we know from the new Civil Aviation (Licensing) Act, some extraordinarily silly things can come out of revised government legislation; and now that they are in the mood to do something about airports and technical services the final result may not be anything like that expected by the aviation community. The Ministry of Aviation's new regulations for non-scheduled aircraft at Heathrow point the way to how things might go, even in the hands of an independent airport authority, unless the private aviation movement presents a coherent picture of basic rights for all to follow. The business user is at last recognized in a strange sort of way, but there is no joy for the pleasure or recreational aircraft. When one considers that the vast number of passengers using the airport are pleasure-seekers off on a binge, and "peak hours" are the holiday-makers' hours, the appalling facts are apparent. If the implications were not so serious it would be funny, and it's to no one's credit that they have got away with it. What is there so special about the business user? We're in that side of the movement but we are also the last to accept that the business user should be given preferential treatment over his pleasure or indeed commercial counterpart.

These are just a few of the vital aspects which must be kept in mind while the new legislation is prepared and the old untangled. What is needed is a totally independent statutory authority, person or body of persons, charged with the sole task of upholding the rights of the individual in the air and entitled to question the acts of any authority, private concern, or the terms of any legislation, which appear to cut across the sanctity of those rights. This is not a matter which can be adequately dealt with by other means.

Redhill Aerodrome, Surrey — J. V. HOSE, Director, Business Aviation Ltd.

Flying Scale Models

I READ with interest the letter about the flying scale-model Constellation in your issue of August 17. What is otherwise a fine model could have been even better with scale airscrews and unobtrusive positioning of the cylinder heads.

My own model Avro 748, though by no means as good as the Constellation, has four-bladed props and cylinder heads inclined inwards towards the fuselage. I think this improves the appearance of the model and is not difficult to do. The engine position is merely a matter of design; and the props, in my own case, were made by lap-jointing a pair of commercial wooden ones. Due to the small size of the full-size aircraft spinners the engine prop-nuts were discarded and fresh ones turned from Dural block.

Looking back through my records I came across all my calculations, and readers may be interested in the work that went into the design side of the model. At the time I was employed in the wind tunnel department of A. V. Roe & Co Ltd and had, in fact, taken part in tests on the 748, so I had available aerodynamic data and extensive scale drawings. The calculations included plots of trimmed lift, drag and speed/lift curves for several possible all-up weights. Prop/engine characteristics were included and the calculations ended with the elevator angles required at touchdown, together with the take-off and maximum speeds.

One of the greatest worries with a multi-engined control-line model is the possibility of in-swinging if the inside engine cuts first. The model incorporated several safeguards, including weight in the outer wing-tip and offset rudder and ailerons, both at pre-calculated angles. The weight came out at 5lb and as far as we could measure the performance was that which had been calculated, i.e.:—

Maximum speed . . . . . 74ft/sec, angle of attack, 1.8°
Touchdown speed . . . . . 38ft/sec, angle of attack, 12.5°
Single-engined speed . . . 52ft/sec, angle of attack, 5.0°

Hazel Grove, Cheshire — M. A. HUNDLEBY

Aeronautical Dogmatism

READING the letter from Kurt Kaye-Nein in your August 17 issue (page 235), I was reminded of another example of a dog who loved flying. His owner was a Dutch military pilot flying a B-25 bomber in a Dutch bomber squadron operating from an air base near Darwin, Australia, during World War Two.

This pilot took his dog, a terrier called "Stupid," with him on all his missions—at least forty. "Stupid" was never nervous or afraid during bombing raids or air fights, but he always became very excited as soon as the aircraft came near to the runway in the final approach before landing. "Stupid" and his master both survived the war.

The Hague, Netherlands — K. AKKERMAN, Lt Col, RNAF

M Maigret, Magician?

ONE of the more remarkable attributes of the M Maigret mentioned by your correspondent Mr Wilson in *Flight* for August 24 seems to be that of transferring from one aircraft to another in flight. On the journey in question he viewed the scenery through a *circular* window, the external shots were of a Viscount 802 (suspect G-AOJA), while he disembarked from the elliptical doorway of a Viscount 701. Who is to blame, the cameraman, the producer or the publicity boys?

Weybridge, Surrey — PETER R. WHITE

General V. M. Tkachev

RECENTLY I received from the former C-in-C of the Russian Air Service, General V. M. Tkachev, CMG, DSO, etc, Ret, a letter in which he writes: "A squadron of RFC operated on the Russian front in 1917 in the region of Brshesany, near the village of Podgaitzy. The British pilots Smith, Abercromby (the name is not shown correctly) and Neville time and again strafed the enemy, flying in Sopwiths which were armed with Vickers machine-guns. I was eye-witness when once one of the above-mentioned British pilots took off from his aerodrome: at first he flew on the rear of our front gaining height, then he dived on a German kite-balloon which was near the sea in the vicinity of Brshesany. In pressing home his attack the British pilot shot in flames a Russian gas-holder which was located in the vicinity of this sea, in our rear. The pilot could not get out of his dive at this low altitude and was caught up in the trees . . . but fortunately without harm to himself. Both the enemy and our army had the 'bubbles' in the vicinity of this sea, and the British pilot had miscalculated. This British squadron competed with the First Fighter Group of Maj A. A. Kazakov, DSO, which was located in the neighbourhood."

Here is an extract from a Russian Army order in French: "Les pilotes de chasse britanniques Smith, Abercromby[?] and Neville sont de très grande valeur, fait l'admiration des pilotes russes depuis ce an, ils participent volontaires pour toutes les missions les plus périlleux et particulièrement distingués au cours des opérations actuelles. . . ."

Gen Tkachev is my aviation godfather. Probably he is the greatest of all reconnaissance flyers of World War One. In 1914, 1915 and 1916 he three times "won" 200,000 men: (1) on August 12, 1914, he rescued the Russian Fifth and Fourth Armies (the Russian south-western front), and 200,000 Russian soldiers got out of enemy encirclement. (2) During an air reconnaissance in the summer of 1915 he discovered in the region of the south-west of Mitau, Latvia, a German motorized corps which aimed to force the Düna River. This corps was annihilated near Jakobstadt and the Russians took

200,000 prisoners. (3) On air reconnaissances in the region of Berestechko, Galicia, on June 19-27, 1916, he discovered that at the junction of the Eleventh and Eighth Armies a large German unit would encircle the left flank of the Russian Eighth Army. The Russian armies attacked this enemy unit and took 200,000 prisoners.

For these air reconnaissances, Capt of Cossack Artillery V. M. Tkachev was awarded the St George Order (Fourth Class), was knighted, was given the very rare award of the Gold Sword of the Order of St George (usually reserved for high-ranking officers), was appointed CO of the Eleventh Air Wing, and in 1917 made C-in-C of the Russian Air Service. His Majesty King George V awarded him the CMG and DSO. He was promoted lieutenant-colonel, colonel and major-general. During the Civil War he was the C-in-C of the Russian Air Forces in South Russia.

He emigrated to Yugoslavia where he was the editor of an aviation magazine; later he worked as a bookbinder. After the Second World War he was repatriated to his homeland, Kuban (he was a Kuban Cossack and a personal friend of the famous Capt P. N. Nesterov), and still lives as a pensioner in Krasnodar, Kuban. Recently he wrote a book about his fellow pilot Nesterov, *Russian Eagle*, and is now writing his war memoirs.

Tartu, Estonia E. MEOS

[We have elected to publish this letter much as received, rather than risk misinterpretation of General Tkachev's letter.—Ed.]

Winton Aerodrome

I AM writing as an old-timer to ask whether your readers can give any details of the old Winton Aerodrome outside Bournemouth, of 1917-18 and onward a bit. A Mr Winter from Grahame-White's Hendon school was chief instructor. Later came a Mr Tollerfield, who worked during the last war at BAC Rodney Inspection. Manager at Winton, and I believe the owner, was Mr Etches.

A few weeks ago one of your correspondents wrote regarding the *Daily Mail* 1911 Round Britain Race. The writer took part in this by trying to chase the Bristol aircraft with a converted French-built Charron taxi. The body was removed to form an open truck.

Your founder, Mr Spooner, found me my first aircraft job with the late Capt Bertram Dickson. I had Mr Montague Napier's permission to leave his company to join the British & Colonial Aeroplane Co. Mr Napier told me: "I think you have something, Solomon, in this aeroplane business"!

18 Queen's Drive, Bristol 7 HAROLD SOLOMON

FORTHCOMING EVENTS

Sept	11-15	Royal College of Advanced Technology, Salford: Course on Noise Measurement.
Sept	11-17	Battle of Britain Week.
Sept	13-17	German Aero Club: 2nd International Sporting Pilots' Rally, Baden-Baden.
Sept	15	British Interplanetary Society: a.g.m.
Sept	20	Kronfeld Club: "Italian Nationals," by Philip Wills.
Sept	23-24	International Grand Prix for Light Aircraft, Bourges.
Sept	27	Kronfeld Club: USAF Film Evening.
Oct	2-7	12th International Astronautical Congress, Washington DC.
Oct	4	BritIRE: "Methods Used for the Study of Vibration in Aero Engines," by D. A. Drew.
Oct	4	Kronfeld Club: Debate on "Gliding should be Government Subsidized."
Oct	5	International Airline Navigators Council: Pacific Regional Meeting, San Francisco.
Oct	5-6	Aerodrome Owners Association (Leeds and Bradford): Conference, Harrogate.
Oct	7	Kronfeld Club: Annual Dinner and Dance.
Oct	7-8	Genoa Rally.
Oct	10	RAeS (Luton Branch): Film Evening.
Oct	11	BritIRE (South Western Section): "General Introduction to Inertial Navigation," by R. Collinson, and "Components and Techniques Employed in Inertial Navigation Systems," by E. Bristow.
Oct	11	Kronfeld Club: USAF Film Evening.
Oct	12	Guild of Air Pilots and Air Navigators: Lecture, "Stress and Human Performance," by Air Cdre W. K. Stewart.

Aeronautical Inn-signs

I HAVE just returned from holiday and, catching up on my *Flight* reading, I enjoyed Leslie Hunt's article "Local Flying," in the issue of August 10. A couple of years ago I was delighted to see a small country pub at Desford in Leicestershire bearing the name "The Lancaster" and sporting a fine illustration of a "Lanc" on its sign.

Attenborough, Notts N. ESCOTT NORTH

CORRESPONDENCE IN BRIEF

Malcolm D. N. Fisher, of the Air-Britain Air Relics Research Group, writes to ask for information on the RAF history of the Mk 9 Spitfire NH238 which suffered damage to its port wing during the London-Cardiff Race early in June. He would particularly like to hear from anybody who served with the squadron to which this aircraft was issued, and anyone who prepared it prior to shipment to Belgium for service with the Belgian Air Force. Mr Fisher's address is 300 Coulsdon Road, Old Coulsdon, Surrey.

THE INDUSTRY

New Locking Compound

BOTH MoA and ARB approval has been given to Loctite sealant, a new liquid polymer for the bonding of metal parts which has found wide application in the aviation industry, particularly for locking and sealing threaded fasteners against vibration. Listed among users, it is stated, are BEA, de Havilland, Blackburn Aircraft, Short Bros and the RAF.

Loctite is a non-volatile thermosetting plastic with the property of conversion from a low-viscosity liquid to solid form in less than 15min when confined between closely fitting metal parts; it continues to gain strength to a fully hardened condition in eight to ten hours. No mixing or preparation is required, and the low viscosity permits penetration by capillary action even to pre-tightened assemblies. Once hardened, the sealant is resistant to chemicals, oils, fuels, water and most known solvents in a temperature range from −65°F to +350°F. A recent application has been on the retaining nuts and bolts of the "Dover sole" engine fairings on BEA Viscounts.

A product of the American Sealants Co, USA, Loctite is marketed in the United Kingdom by Douglas Kane (Sealants) Ltd, 243 Upper Street, London N1.

Gp Capt Hamish Mahaddie, DSO, DFC, AFC, AFRAeS, 118 Mount Street, London W1, is aeronautical consultant to the company's aviation division.

IN BRIEF

Mr D. H. Young, AMIMECHE, FBIS, has joined the staff of Hale, Hamilton (Valves) Ltd as general sales manager.

Director of technical services at Metalastik Ltd, Mr G. F. Laurence has been appointed a deputy managing director of the company.

B.S.T. Aeronautical Co Ltd are at 84 Alexandra Road, Farnborough, Hants, and not at 84 Farnborough Road as stated in our Ancillary Industry directory on August 31.

Lloyd Instruments Ltd have acquired larger premises and their new address (to which the subsidiary company H. Millington is also moving) is Furrow Lane, Homerton High Street, London E9 (AMHerst 6578).

Appointed director and general manager of Aircraft-Marine Products (Gt Britain) Ltd, Mr G. H. J. Munro joined the company in 1957 as sales manager, moving into general management early this year.

Formerly director of research with Tube Investments Ltd, and before that chief superintendent of the rocket propulsion department at RAE Farnborough, Dr T. P. Hughes has become joint assistant managing director of B.B. Chemical Co Ltd.

An international conference on The Metallurgy of Beryllium has been arranged by the Institute of Metals. It is being held in the assembly hall of the Royal Commonwealth Society, Craven Street, London WC2, from October 16 to 18. Full details may be obtained from the institute at 17 Belgrave Square, London SW1.

Vactric Control Equipment Ltd have stated that at the time of the acquisition of their share capital by the *News of the World* Organization, mention was made that it was planned to expand the company's facilities. "Substantial premises" have now been acquired at Garth Road, Morden, Surrey; top priority is to be given to the erection of a new block to house the development and applied research departments. As additional space becomes available the company will gradually concentrate all its activities into this area.

Lord Baillieu, Australian-born president of the Dunlop Rubber Co and chairman of the English-speaking Union, has travelled well over a million miles by air since he first took up flying fifty years ago. To mark this achievement a triple presentation was made recently to Lord and Lady Baillieu and to Miss L. E. Watson, his personal assistant (who has also completed a million flying miles), by Mr G. W. Armstrong, European director of United Airlines Inc.

The Plessey Co Ltd have announced the appointment of Brigadier J. D. Haigh, OBE, MA, MIEE, as general divisional manager of a group of divisions including the wiring and connectors division, capacitors and resistors division and Preformations Ltd. Brig Haigh, who joined Plessey in 1958, was one of Britain's early radar experts. Since February last year he has held the position of divisional manager at the Plessey capacitors and resistors division, Swindon.

Mr J. D. Percy was recently made technical sales manager of Cossor Radar and Electronics Ltd. One of John Logie Baird's original band of assistants at the very start of television in 1928, he remained with Baird until the outbreak of the Second World War, during which he served with the Royal Navy and subsequently the Royal Canadian Navy. He joined Cossor (Canada) on leaving the RCN in 1955, transferring to Cossor Radar and Electronics at Harlow in 1958.

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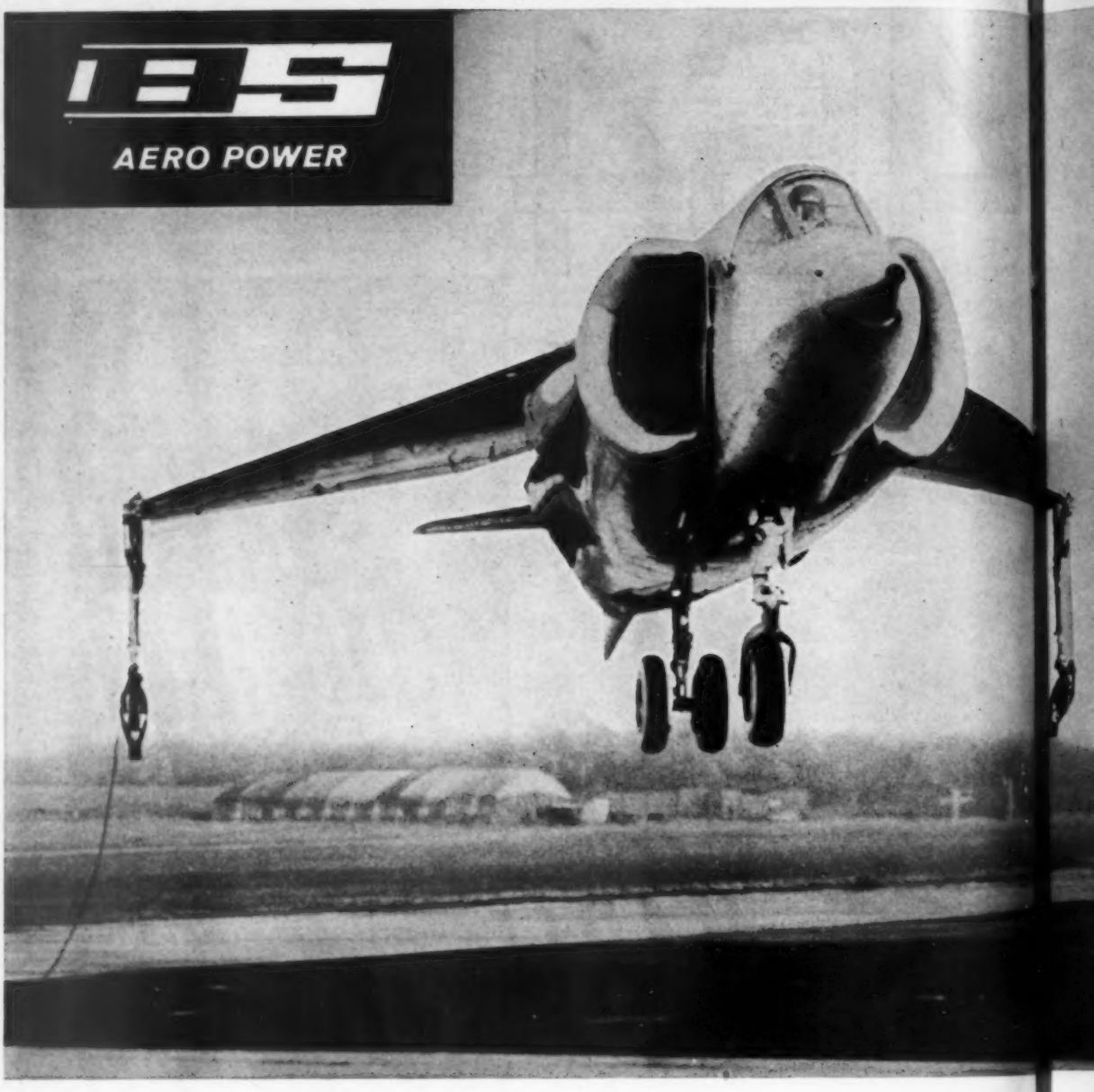
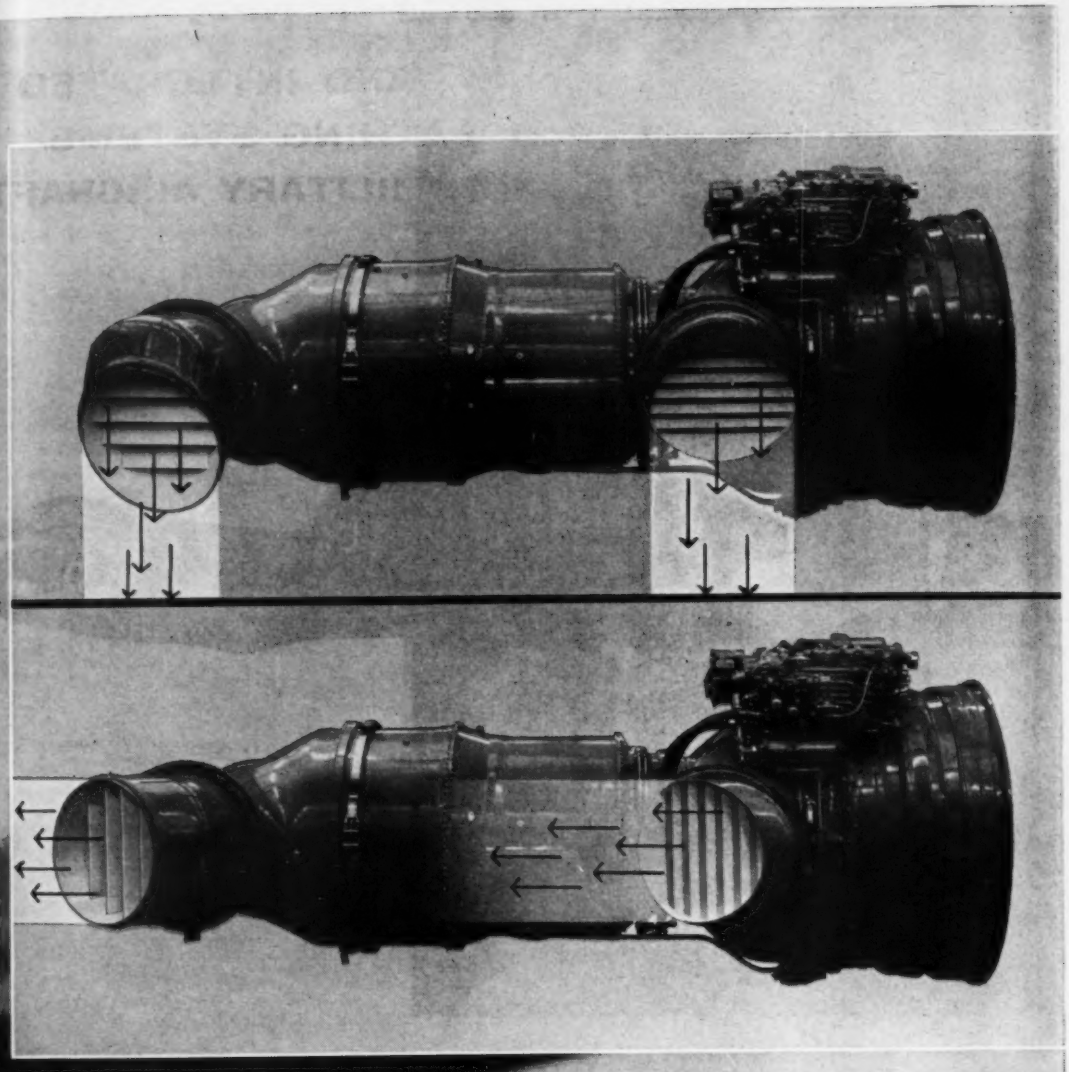
LIVES SAVED TO DATE BY MARTIN-BAKER EJECTION SEATS

M-B A

BS
AERO POWER



LIFT and THRUST from ONE ENGINE—the revolutionary Pegasus turbofan



The new Bristol Siddeley Pegasus high-ratio turbofan represents a major engineering breakthrough in the field of aircraft propulsion.

Because the Pegasus can be fitted with movable nozzles evenly disposed around the centre of gravity which give directional control to its total thrust, this remarkably versatile engine provides the airframe designer with *a single power source for all conditions of flight*.

VTOL, STOL and normal take-off capability in the same aircraft. Suitable for subsonic or supersonic applications.

High by-pass ratio gives high thrust for low weight, low fuel consumption and low noise level.

Conventional installation. Operational simplicity. Independent of all fixed ground installations.

Problems of ground erosion, recirculation and ingestion of debris reduced to a minimum.

The Bristol Siddeley Pegasus has already been selected for, and is now undergoing trials in the Hawker P 1127 VTOL light strike aircraft and is supported by the Mutual Weapons Development Programme for NATO.

BRISTOL SIDDELEY ENGINES LIMITED TURBOJETS—TURBOFANS—TURBOPROPS—RAMJETS—ROCKET ENGINES—PISTON ENGINES—MARINE AND INDUSTRIAL GAS TUBINES—MARINE, RAIL AND INDUSTRIAL DIESEL ENGINES—PRECISION ENGINEERING PRODUCTS.

NEW AND INTEGRATED BREATHING SYSTEMS FOR MILITARY AIRCRAFT

Protection at Altitude and Safety in Emergency

NORMALAIR oxygen breathing equipment is fitted to all front line R.A.F. Aircraft and to those of seventeen Air Forces all over the World.

The new Normalair seat mounted oxygen regulator system, integrated with the Normalair Emergency Oxygen Regulator, represents advanced design to improve performance and to simplify operation, installation and maintenance in high performance military aircraft. The Emergency Regulator not only provides for oxygen breathing on aircraft evacuation – it can also be used to regulate the oxygen supply to the crew members in cases of cockpit contamination or other flight emergencies.

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EUROPE'S LARGEST AND MOST EXPERIENCED PRODUCERS OF AIRCRAFT CABIN AIR CONDITIONING SYSTEMS AND COMPONENTS

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Straight and Level

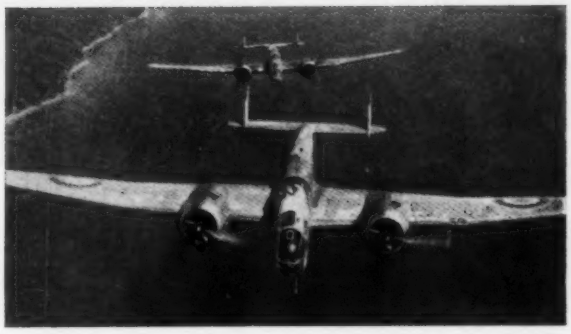
ALAS, Straight and Level's complete report on the SBAC Display was not ready in time for last week's issue. I am sorry about this, but our air expert—Dr J. Nit—unfortunately succumbed to the hospitality for which Scruggs is so justly famous, and was found unconscious in a brochure cupboard on the company's stand when last week's issue was due to go to press. However, better late than never (as Scruggs always say).

Attracting enthusiastic interest on the **Fred Aviation Ltd** stand [writes Dr Nit] was the prototype of the **Fredonics** Mk 1 Model 321 Enthusiasm Simulator, which will be available in time for delivery to visitors to next year's show. **Flight Falsies Ltd** displayed a complete new range of their Simulated Customers, in "Falsi-Foam" flexible rubber. These high-precision reproductions are uncannily lifelike, and typical models available for immediate delivery to other exhibitors, and which are representative of the most desirable sales prospects, included Venezuelan Air Force generals, Pan American vice-presidents, Canadian bush pilots, senior Ministry of Aviation officials, and Howard Hughes. These imitation customers can be most effectively displayed at the show posing for contract-signing photographs with the chairman, or having lunch, or chatting with the managing director outside the President's enclosure, etc, etc.

A promising new range of products by **Smashing Junket (Potters Bar) Ltd** attracted keen interest from other exhibitors. In greatest demand were crates of realistic-looking empty champagne bottles and half-eaten plastic grouse which, when positioned outside enclosures (reads the brochure) "never fail to impress visitors to neighbouring enclosures."

Finally, in the missile park was the Crimson Leak, the Fred-Scruggs Group's new surface-to-air missile designed to be fired from horseback by officers of the Household Cavalry riding side-saddle. Its guidance system consists of a miniaturized computer that can be easily accommodated under a standard bearskin, and a special gyro is designed to provide trajectory-correction if the horse rears suddenly at the moment of firing. The umbilical mast is disguised as a sword scabbard, and the erector-launcher elevator powerpack digitizer is completely concealed by horse-brasses. "This latest manifestation of British creative design genius," said Sir John Blackout-Jones at a press conference, "will appeal particularly to economy-minded governments who wish to get in on the missile age while retaining all the pomp and circumstance of past military glories. I need hardly tell you that the War Office is very interested indeed."

Asked to comment, General Sir Jocelyn Flamethrower, KCB, DSO, MC, said: "Gad, sir! It is absolutely splendid! If only we'd had 'em at Balaclava."



This picture was published in "The Link," magazine of the Canadian Joint Air Training Centre, Rivers, Manitoba, with the caption: "Hampden bombers in line-astern formation. Note the bend in the fuselage denoting its great flexibility." Any comments from former Hampden pilots, or members of Handley Page's structures dept?

● Mr Myles Wyatt, chairman of British United Airways, writing in *The Times Survey of British Aviation*, says that "it is open to debate, to say the least, whether these cosy arrangements [the corporations' pooling agreements] are either in the best interests of British travellers or are the best means of earning the maximum amount of foreign currency."

Splendid straight-talking stuff. But does Mr Wyatt feel this way about his own pooling agreements with BOAC in Africa, and with BEA in the Mediterranean, out of which his airline has not been doing at all badly?

It is no good saying that BUA were forced into these pools by a Ministerial shotgun: the Minister's view, as recorded in these columns, is that pooling is "a matter for the commercial judgment of the airlines."

Good fighting anti-pooling talk, British United, but *tu quoque*.

● You remember that recent joke about the recorded announcement to passengers in the first pilotless airliner, ending: "*Ladies and gentleman, you have nothing to worry about . . . to worry about . . . to worry about.*" If not, pass straight on to the next item—the remainder read on.

Now I am wondering whether the Ferranti audio warning system, which feeds spoken warnings into the pilot's earphones if something important fails, also has an announcement saying that the audio warning system itself has failed and that the pilot should expect no warnings. If Ferranti have solved the problem of making something announce that it has failed, after it has failed, they might provide the automatic-landing designers with a device which would feed into the cabin address system a message—which would have to be brief—like "Cheerio."

● *Farnborough customer:* "Now can you give me a firm price for this equipment? Don't tell me it will cost about £500 and then give me a bill for £600."

Company salesman: "Ah, I see you know our company."

ROGER BACON

He can laugh, because he is the great A. V. Roe himself, designer as well as pilot of this 1910 triplane. Clearly, A. V. Roe the pilot was about to have a word with A. V. Roe the designer: no doubt each said, "I can explain everything."

Missiles and Spaceflight

(continued from page 414)

MILITARY SPACE-TRACK SYSTEM

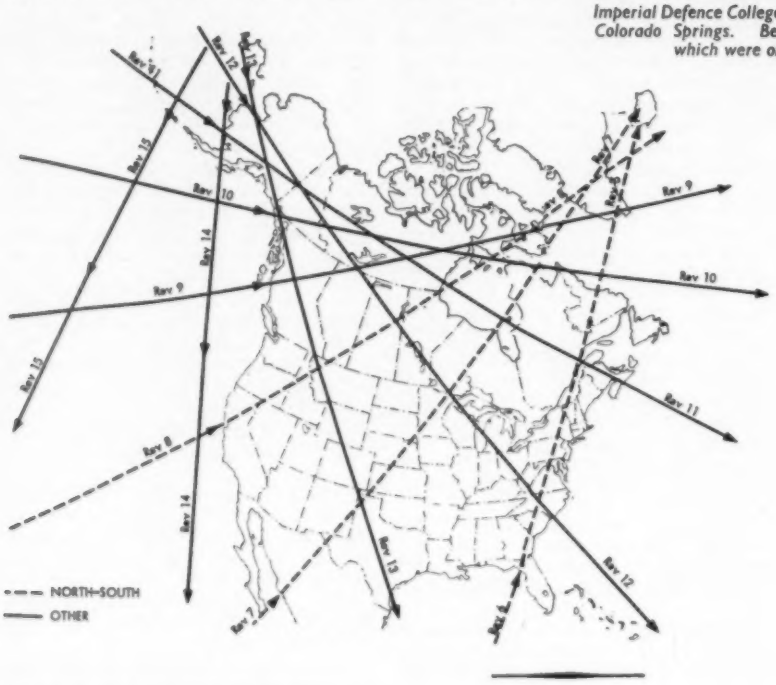
The newest addition to the warning facilities employed by North American Air Defense Command, Colorado Springs, is a satellite tracking system designated SPADATS (Space Detection and Tracking System). This system, which came into use on July 7, is based on a number of detection and computer centres, and a SPADATS control centre at Colorado Springs. At the control centre, satellite data are displayed on a main status board, and this information is conveyed to the NORAD combat operations centre by means of closed-circuit television.

Observations made by the Ballistic Missile Early Warning System radars are passed to the SPADATS control centre by teletype line. Similarly, the USAF Space Track Research and Development unit at Hanscom Field, Massachusetts, relays information by teletype, and is connected to the control centre by telephone. The Hanscom Field information comes from satellite visual observations, tracking radars, and photographs taken by Baker-Nunn cameras.

Other information is passed to Colorado Springs from the detection network, tracking and prediction centre and display system of the US Navy's SPASUR (space surveillance) system; a USAF tracking station at Laredo, Texas; NASA's Goddard Space Flight Center, Greenbelt, Maryland; the NASA Minitrack network; the Baker-Nunn cameras of the Smithsonian Astrophysical Laboratory; the Discoverer satellite centre at Sunnyvale, California; the Atlantic Missile Range at Patrick AFB and Cape Canaveral; the National Security Agency; and the Security Service Office of the USAF.

"Within one to four years," a NORAD Headquarters spokesman states, "it is expected that SPADATS will have to be equipped with the means to provide warning of hostile activity in space; to determine the purpose and capability of unfriendly space objects; to provide space traffic control; to provide operational support to anti-satellite weapons when these weapons are developed; and, as directed, to be able to provide support to US space and weapons activities.

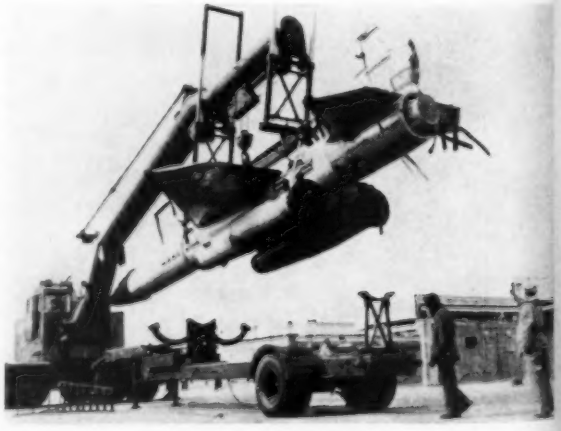
Imperial Defence College students visiting the SPADATS operations room at Colorado Springs. Below, record of the Titav orbits, forecasts for which were obtained using a Philco 2000 computer



BRITISH CRANES FOR US MISSILES

It is not generally known that at least one well-known British make of crane is widely used in the USA, both in missile manufacturing plants and at launching sites. The company which makes this equipment is justifiably proud of its success in the face of nation-wide competition from the country which is recognized as the home of mechanical handling.

A spokesman for Steels Engineering Products Ltd, designers and manufacturers of Coles cranes, and a subsidiary of Steel & Co Ltd, claimed to be the world's largest crane-producing group, had this to say on the choice of this equipment for missile handling: "Coles cranes were selected primarily for their accuracy in handling; they can raise or lower a load fractions of an inch with a sensitivity of control unequalled by any other. Reliability was another important factor governing the choice. Coles diesel-electric power is always instantly available, and the many safety features automatically protect the operator and the enormously valuable load." He quoted as an example of Coles precision the positioning of a missile below ground level with critical lateral accuracy. Already Coles truck cranes are working on the Titan I complexes, and self-



Coles crane handling an IM-99A Bomarc area-defence missile at a USAF base on the Eastern seaboard

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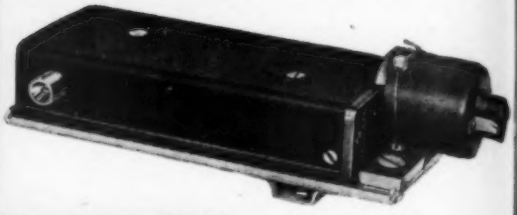

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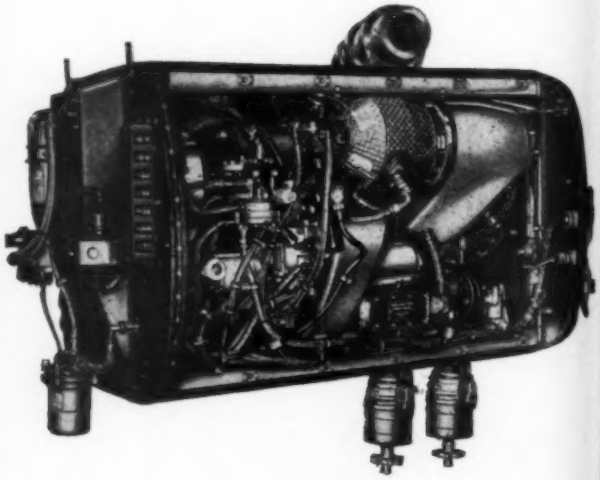

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Missiles and Spaceflight . . .

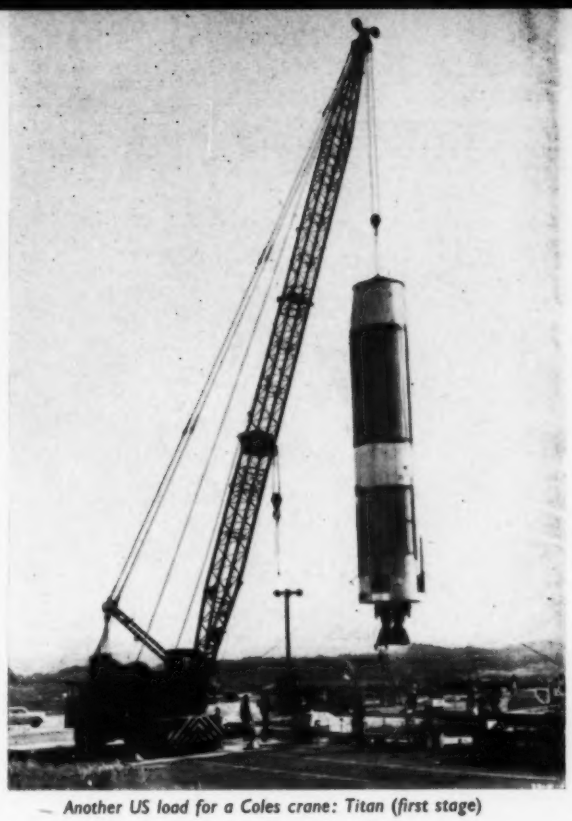
propelled machines on the launching sites of the Bomarc A squadrons. Others are operating in factories producing engines for Bomarc and Minuteman.

A feature of some of these cranes is the provision of a remote-control system, which provide supreme accuracy in positioning a missile. This method is used to control craning operations when lowering an ICBM to its launching pad below ground. The remote-control console is a closed-loop servomechanism, connected by shielded electrical cable to the crane's superstructure and operated by a man at the bottom of the silo where the load's actual position can best be observed. The compact control box has control switches duplicating those in the crane cab, and all operating functions can be controlled hundreds of feet away from the crane.

The Norwegian Foreign Ministry announced on September 5 that Norway did not intend to participate in the proposed European space launch-vehicle development programme, although the country would like to send an observer to attend the forthcoming intergovernmental meeting in London.

Mr Thomas F. Dixon, vice-president for research and engineering of Rocketdyne, is to succeed Maj-Gen Don R. Ostrander as Director of the National Aeronautics and Space Administration's Office of Launch Vehicle Programs on September 18. Gen Ostrander is returning to the USAF as Vice-Commander of the Ballistic Systems Division, Air Force Systems Command.

A $6.3m, six-month contract for the first-phase development of NERVA (nuclear engine for rocket vehicle application) has been awarded by NASA and the Atomic Energy Commission to Aerojet-General Corp. In addition, a subcontract has been negotiated between Aerojet and Westinghouse Electric Corp under which Westinghouse will be responsible for the nuclear portion of the work. NERVA is part of the Rover programme.



Another US load for a Coles crane: Titan (first stage)

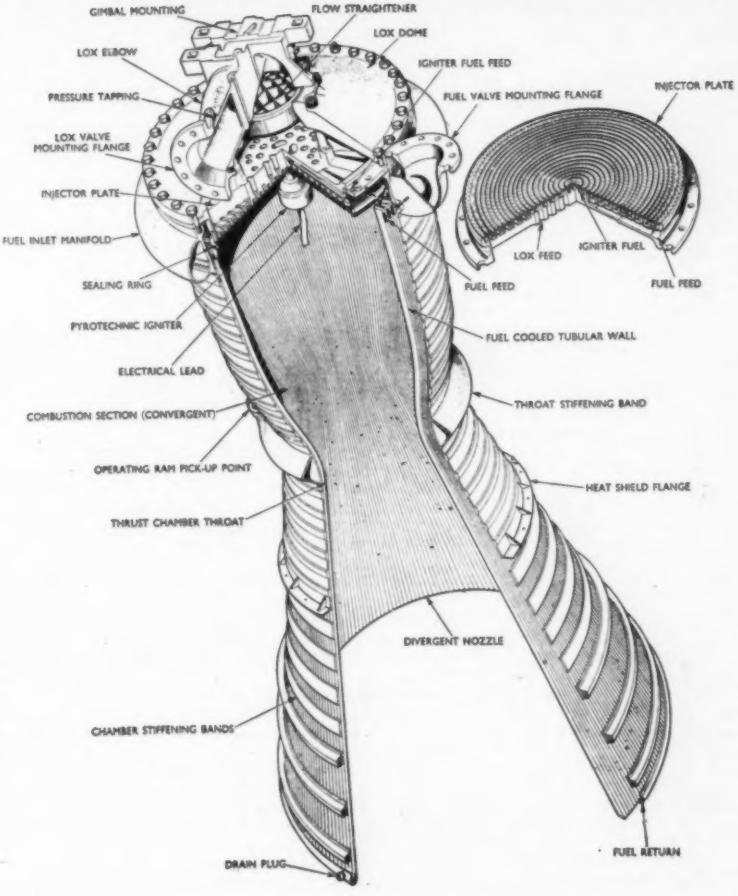
THRUST FOR EUROPE'S SPACE PROGRAMME

IN the report of propulsion developments written at Farnborough it is stated on page 441 of this issue that Bristol Siddeley Engines Ltd are working in the field of rocket propulsion on a broader front than any other British company. But Rolls-Royce alone have experience of the size of liquid-propellant engine necessary for large ballistic vehicles and spacecraft booster, their work being based upon original research and development undertaken by the Rocketdyne Division of North American Aviation, with whom a technical agreement has been operative since 1955.

The drawing at right was prepared by a Rolls-Royce artist to clarify the construction of the thrust chamber of the RZ.2 engine, two of which power the de Havilland Blue Streak. The complete engine was exhibited at Farnborough last week—the first time it has been seen in public.

The future of the proposal to develop a European launch vehicle using Blue Streak as a first stage will be decided at an intergovernmental meeting in London shortly. West Germany has agreed in principle to the proposals, and will make the third stage if the project goes ahead. France will develop the second stage.

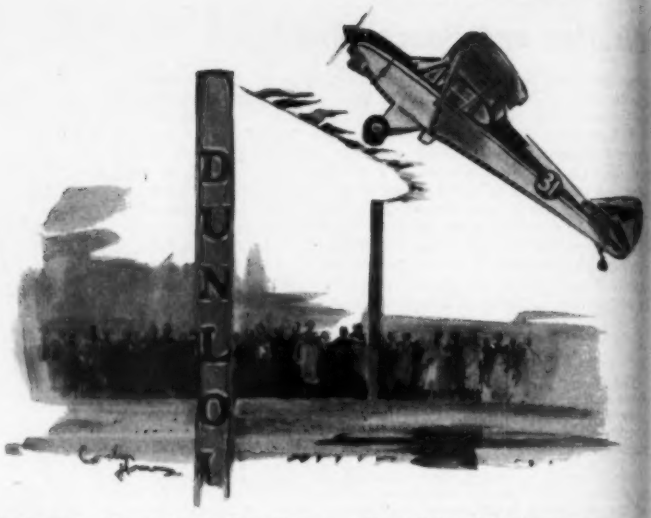
Rolls-Royce, managers of the Ministry of Aviation's Rocket Test Establishment at Spadeadam, Cumberland, continue to prove the complete RZ.12 powerplant of the Blue Streak, consisting of two RZ.2 engines installed independently. Each has a thrust chamber constructed from 312 nickel tubes, shaped to form a convergent/divergent nozzle when brazed and welded together and strengthened by welded bands to withstand the chamber internal pressure when firing. The kerosine fuel circulates through the tubes (down to the rim of the nozzle and back to the head of the chamber) to keep the walls cool. Further details of firing trials are given on page 437.



SPORT AND BUSINESS

Private View

BY P.P.O.



"It was won by Toss Murray . . . Most of the take-offs were quite hair-raising, but probably a good deal safer than they looked."

THE cost of an aeroplane, as indeed of a motor car, is simply the price you paid for it plus what it costs to fly, insure, hangar, and maintain, minus what you get for it when you sell it. If you divide the resultant sum of money by the number of hours flown, you clearly get an hourly cost. I have a feeling that, by this way of reckoning, the hourly costs of some aircraft will come out rather different from those given in the manufacturers' catalogues.

In the sailing world, it is quite common for young men to get their sailing for nothing by buying old boats in bad condition, working hard on them, sailing them in races, and eventually selling them for a lot more than they cost.

My first aeroplane I bought off a scrap heap for £50 and nearly sold it for £300, but that was before the days of the ARB, and I didn't actually sell it because, while the deal was being negotiated, I hit the top of a fence in a forced landing, which didn't improve the sales value of the aircraft. You can't do that sort of thing nowadays. By the time you have got your C of A, so many months will have gone by and so much money will have been spent that both your bank balance and your enthusiasm will have disappeared.

Second-hand aeroplanes should maintain a pretty good sales value but it is certain to vary from one make to another, so before you do decide on your mount, do a bit of calculating and check up on second-hand prices. Aeroplanes are subject to the laws of supply and demand like everything else and, if there is likely to be a lot of used aeroplanes of any particular make on the market, it is certain that their second-hand value will be lower than that of another kind which may not be so easy to find.

On the question of utilization, calculate carefully how many hours' flying you are likely to do in a year. With these figures in mind, and a fair idea of what you may get for your aircraft if you should want to sell it after a few years, you will be in a good position to make your final choice a wise one.

★ ★ ★

Everybody seemed to enjoy the King's Cup race meeting at Coventry earlier this summer, in spite of the weather. There is a friendly, sporting atmosphere among air racing pilots which makes taking part in these races something which you remember with pleasure all the rest of the year. We all hope that other big cities will follow the example of Bristol, Cardiff and Coventry, and promote an air race as part of their annual air day.

If you are thinking of having a go at racing, please take every opportunity you can of practising racing turns. The great enemy of safety in air racing is the climbing turn, which is very easy to do when your craft is going at full speed. The reason it is so dangerous is this: on approaching the turning point you are naturally looking down and, if someone is coming up behind you and turning at the same time, the chances are that as he banks you will be out of sight under his left wing. If you climb, therefore, the two of you may collide without either seeing the other.

Courses are best arranged with four turning points, all (if possible) in sight of the spectators, and all legs roughly at right angles. Courses need not be too long, and you can have plenty of aeroplanes competing together if they vary slightly in speed.

I was sorry at Coventry for those pilots who had entered for the Cardiff races but had failed to qualify for the King's Cup. They had nothing to do, and one wonders if it might not be possible to run a sort of consolation race for them at Coventry on the lines of the All-England Plate at Wimbledon.

By racing your aeroplane, although you may be taking certain risks, you are certain to learn a good deal about your engine, and also improve your ability to handle your machine accurately near the ground—which can be very handy if you get caught out in bad weather.

The 1961 Lockheed Trophy competition was won, as expected, by a Czech pilot, in particular by our very good friend Jiri Blaha, with two other Czech pilots, Hulka and Trebaticky, well up in the money. But, with no disrespect to our Czech friends, we were particularly pleased that Verette with his Stampe was awarded second place. This seemed to prove that, even in a modern aerobatic contest, it is the pure skill of the pilot and the accuracy of his manœuvres which gain the marks, as well as the performance of difficult and extraordinary figures.

Everyone has to admit that the Zlinn Trener is the supreme aerobatic machine of today; even the Jungmeister does not seem to compare with it, in spite of a high rate of roll. And the Tiger Club's aerobatic Tigers, while giving the British pilots the opportunity of doing manœuvres which they had not previously attempted—and doing them very well—were just not quite powerful or manœuvrable enough to give the jockeys a real chance to get into the final. It is an open secret that the Tiger Club has bought a French Stampe and will be getting it tuned up in time for the 1962 Lockheed Trophy, provided too many difficulties are not raised by the authorities.

Careful examination of the three Stampes at Coventry did not reveal anything very special or particular about them, so that next year, given a little encouragement from the right quarter, it is possible that we may at last have a British pilot in the final.

★ ★ ★

The Business and Touring Aircraft Competition held at Kidlington was an outstanding success. It only needed the "high-jump challenge" involving the Super Cub and the Courier to put the final mark on a most interesting meeting. This challenge was in the real tradition of old-time steeple-chasing to see who could jump over a 10ft barrier with the shortest run. It was won by Toss Murray in, I think, 75yd. Most of these take-offs were quite hair-raising, but probably a good deal safer than they looked.

Naturally enough, the competitors who did not win anything in the touring competition were of the opinion that the rules were not all they should be, but everybody agreed that the idea was a splendid one and that to win it you had to have a jolly good aeroplane. It seemed rather unreasonable to allow competitors to choose the class they entered as one which would give them the best chance on the formula, irrespective of whether they were two-seat, four-seat or six-seat aircraft. The allowance for baggage, too, seemed rather absurd. To argue that any vacant cavity is baggage space will end by people claiming the whole of their fuselage.

Apart from these small difficulties, there is no doubt that this competition is going to be of the greatest possible importance for the future of private flying and air touring. I hope they never bring price into consideration. There is no need to and, if they did, it would make things too difficult. Obviously, the more expensive the aeroplane the more likely it is to win, but if an aeroplane which costs, say, £10,000 gains 2,000 marks, and another which costs £5,000 gains 1,500 marks, the makers of the latter can justly claim that it is better value for money.

Anyway, all thanks are due to the Royal Aero Club for organizing such a first-class competition, and we hope that next year there will be the possibility of going abroad, and of even better competition.

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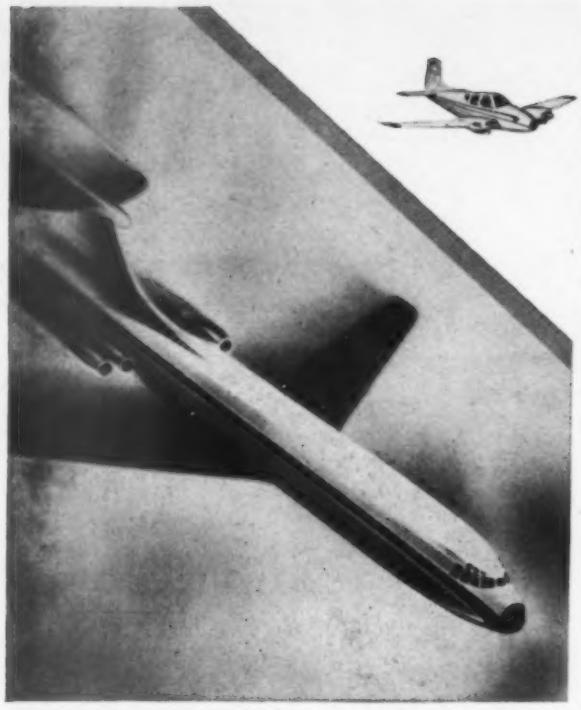

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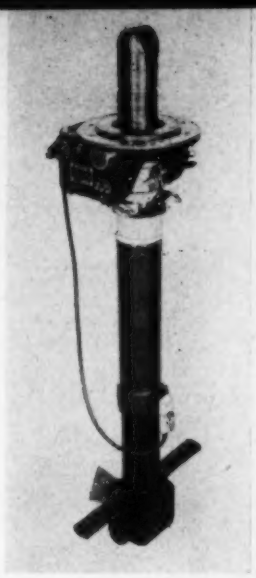


The rear-viewing periscope which is to be fitted to the VC10 to allow the crew to inspect the rear of the aircraft. Fitting in the same socket as the periscopic sextant near the navigating officer's position, the device will allow direct visual inspection from the top of the fin to the engine intakes. Magnification is nearly two-power and the field of view is 20°

Doppler for Mirage III

MARCONI Aeronautical Division announces that the French Government has placed a substantial order for the supply of AD 2300-series Doppler navigators, together with specially designed navigation computers for installation in Mirage III fighters. Marconi Doppler, together with Sperry twin-Rotorace gyro platforms already form the basis of the navigation system in the Mirage IV supersonic strike aircraft.

Midas Forges Ahead

ANNOUNCED during the SBAC Show was an order from British Aircraft Corporation for Royston Instruments Midas flight and maintenance recorders to be fitted in VC10 jet airliners. This marks the first production order for an ejecter-type recorder to solve catastrophic accidents in civil aircraft. In addition to the ejected portion which records operation of major systems in the aircraft for a relatively short time prior to an accident, some 270 parts of the aircraft will be monitored and recorded for maintenance analysis and immediate fault-tracing. The ejected portion carries flotation devices, a homing beacon and marker dye.

Strategic Air Command are already using a non-ejectable Midas recorder on routine missions and TCA are carrying out a full evaluation in a DC-8, which will be reported to IATA. BUA are similarly fitting a Britannia; and a smaller recorder for 90 parameters has already been recommended for use in the flight-test programme of the BAC One-Eleven.

MoA Approves Small Radios

A GROWING number of American small radios for light aircraft is now receiving Class 1 approval from MoA, which means that the equipment is accepted for airways flying. A. J. Whittemore (Aeradio) at Biggin Hill, who are an approved Narco warranty service station and distributors for Britain, received Class 1 approval for the 18oz Narco MBT marker receiver in May and for the Narco Mark V in July. The King 90-channel communications radio is now in Class 1, and the remainder of the King series can be expected to receive approval as well. Joint King Radio distributors in Britain are Vigors Aviation and Airwork Services Ltd.

The range of Motorola VHF radios handled in Britain by Smiths Aviation Division also have Class 1 approval. Most recent addition to Class 1 is the Motorola ADF-T-12 radio compass, the only example of the miniature ADFs to have been so approved. The only modification required by MoA was the addition of a tuning meter to improve sensitivity. This was considerd necessary because of the low transmission powers of British NDBs.

ADF Improvements Sell Well

THE new sub-units for the Marconi AD 7092 ADF, described in these columns on April 20, have been selling well. BEA are fitting the new a.c. power unit to all their AD 7092Ds and have already ordered 100 units. Alitalia, Austrian Airlines, Indian Airline Corporation, Turkish Airlines, BUA and the Finnish Air Force have also placed substantial orders. TCA have ordered 120 of the new transistorized switching units for their AD 7092Gs; and BUA, Austrian Airlines, Indian Airline Corporation and Cunard-Eagle have also ordered them. AD 7092 was put into production twelve years ago and more than 3,500 of them are still serving airlines and air forces.

Handing Over ACCESS

LATE last month Motorola and General Precision handed over to the Federal Aviation Agency the first equipment for a new data link called Aircraft Communications Electronic Signalling System (ACCESS). Using normal voice radio channels, ACCESS will allow high speed transmission of routine traffic control messages between the ground and aircraft. Messages concerned with aircraft identification, weather information and flight clearances would be selected by push-button and presented in visible form at the receiving station.

Doppler for REAL

REAL Airlines have ordered Canadian Marconi CMA-623 Doppler sensers for their Convair CV-900 jet airliners. This latest order brings the number of airlines using CMC Doppler to ten. Repeat orders have already been received. as well as military orders from the United States and Canada.

Czechoslovak Precision Approach

A THIRD ILS installation has been ordered by the Czechoslovak Government from Pye Telecommunications Ltd, this time for installation at Bratislava international airport. The first two Pye systems were installed at Prague international airport. The value of Pye equipment supplied to Czechoslovakia now exceeds £100,000, the latest order including some transistorized radiotelephones for use on Czechoslovakian airfields.

G.E.C. and Storno-Southern

FROM September 4 Storno-Southern Ltd took over the marketing, servicing and installation of G.E.C. mobile radio equipment. An office with sales and servicing facilities and a spares depot have accordingly been opened at 2 Arbury Avenue, Coventry. G.E.C. are continuing to manufacture their range of amplitude-modulated equipment and Storno-Southern already manufacture a range of frequency-modulated equipment.

Raytheon-Elsi AG

UNDER the above name a new company has been formed with headquarters at 1 Alpenstrasse, Zug, Switzerland, to sell components manufactured by Raytheon and Elettronica Sicula of Palermo. Raytheon-Europe AG holds a 51 per cent interest in the new company, the remainder being held by La Centrale Finanziaria Generale SpA. Products to be marketed include microwave, receiving and industrial tubes; transistors, diodes and semi-conductor devices; rectifiers; and magnetic and electro-magnetic components.

Hughes Aircraft Frescan 3-D radar which is being installed on the Italian missile cruiser "Garibaldi." The radar remains in a fixed attitude relative to the ship structure and scans electronically. Ship motion is compensated by a special electronic system in the radar. More than 20 American missile destroyers and cruisers already carry Frescan

Parked in lonely grandeur at San Francisco Airport, this Short Solent was once destined to be operated between Honolulu and Tahiti by South Pacific Air Lines. She never operated the service, but is still airworthy and runs-up her Hercules from time to time. As G-AKNP, the boat flew with BOAC between England and Australia after the last war, and was later used by Trans Oceanic Airways of Sydney

AIR COMMERCE (continued from page 415)

HALF FULL IN EUROPE

THAT the European operations of the 13 member airlines of the Air Research Bureau are faring better than their North Atlantic operations is evident from the first-quarter 1961 statistics supplied by IATA. During the three-month period, international traffic carried by the intra-European operators increased by 15.1 per cent, and capacity went up by 15.9 per cent. Load factor was 50 per cent, about the same as in the first quarter of 1960.

These figures give a general indication of the European trend this year, but they are not strictly representative because fifth-freedom traffic carried by PAA and TWA is excluded, as well as all domestic traffic of the member airlines concerned.

The significant point is that the increase in traffic almost matched the increase in capacity, which is comforting; the real testing time will have been during the second quarter (for which figures are not yet out), when capacity has been outstripping traffic at an alarming rate. BEA's April–July 1961 load factor, for example, fell by 5½ percentage points—and their traffic went up, according to Mr Anthony Milward, at a greater rate than other European operators, some of whose traffic has actually declined.

LOCKHEED'S CIVIL JET FREIGHTER

LOCKHEED'S Georgia division salesmen have started what is described as a "preliminary briefing" of airlines on the capabilities of the Lockheed Model 300, civil version of the C-141 optimum strategic cargo jet. The Model 300 can carry a payload of 85,000lb across the USA non-stop and has a maximum take-off weight of 315,000lb. The cargo compartment is 70ft long × 10ft 3in wide × 9ft 1in high; an additional 8ft of cargo space over the loading ramp brings the hold volume up to a total of 7,156 cu ft. With cargo loaded on ten pallets the palletized volume is 5,484 cu ft. In a military version 100-151 troops or up to 119 paratroops are carried, and entry is through the 10ft 3in wide × 9ft 1in high main loading door 50in above ground. Total fuel capacity is 23,080 US gal with a single point refuelling rate of 900 US gal/min; fuel jettison rate is 700 US gal/min. It will be interesting to see if the Model 300 eventually finds an airline market, or whether it will be "unsold" not only by the Canadair CL-44 and Douglas DC-8F Jet Trader, but by freighter conversions of 707s and DC8s made by airlines who find they have bought too many of these big jets for the passenger traffic available.

Estimated performance of the Lockheed 300: Max cruising speed, 480kt; long range cruising speed, 440kt; aerial delivery drop speed, 115-200kt; take-off distance over 50ft, 315,000lb (military), 5,300ft; landing distance from 50ft at 257,500lb (military), 3,500ft; FAA take-off field length at 315,000lb (civil), 6,000ft; FAA landing field length at 257,500lb (civil), 6,250ft; range (civil domestic version) with 82,000lb payload, 3,450 n.m.; range B (max fuel) (civil domestic version) ,5,800 n.m.; corres payload 40,000lb; rate of climb (sea level, standard day, 315,000lb weight), 3,400ft/min.

Footnote At Farnborough last week a Shorts spokesman said that the company is hoping that BOAC would be the first to place an order for the civil swing nose version of the Belfast.

FALCON AND KOZUBSKI FINED £300

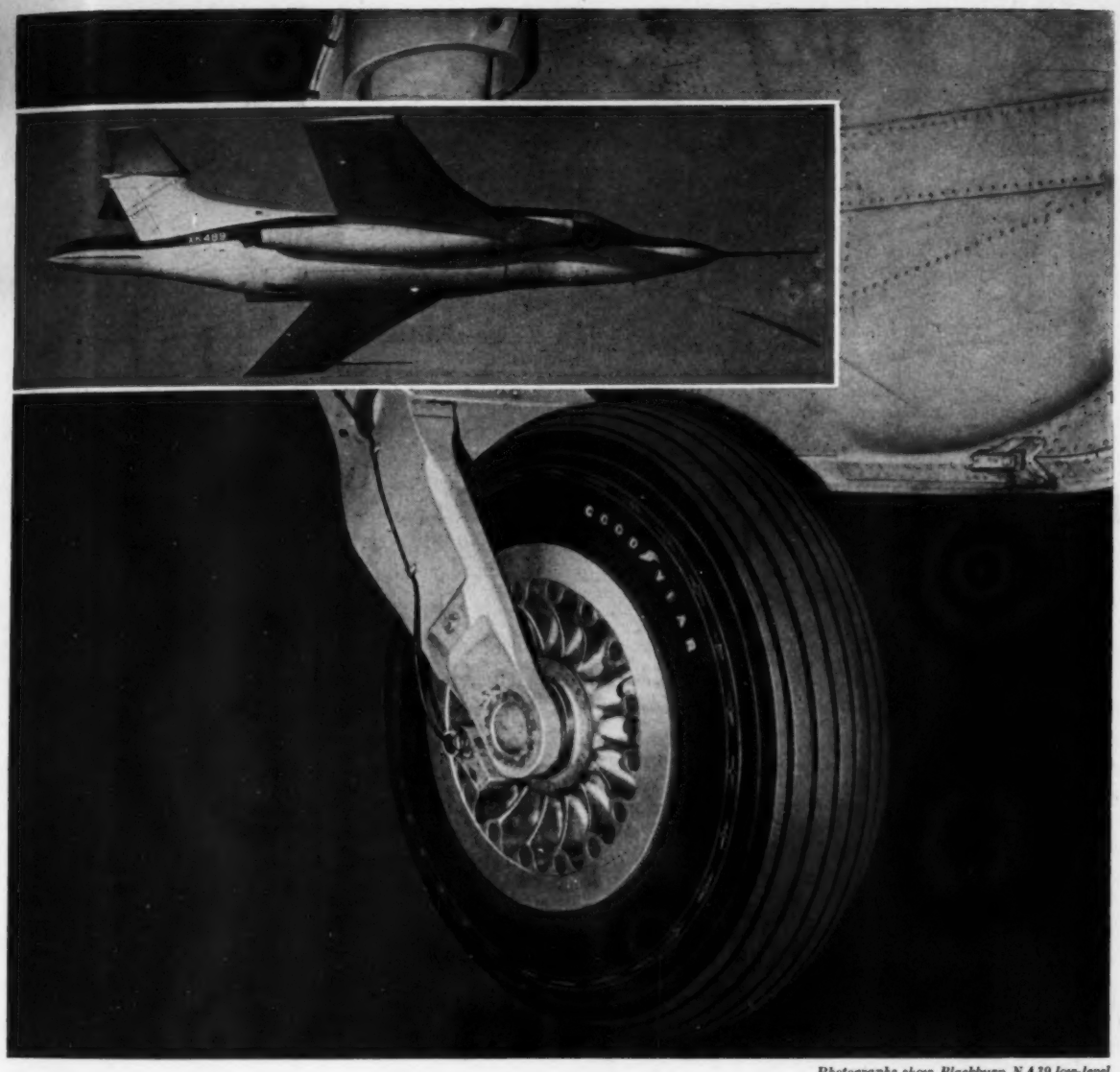
CAPTAIN Marian Kozubski, managing director of Falcon Airways, was fined £175 and the airline itself £125 at Bournemouth magistrates' court on September 6. Each was ordered to pay 50 guineas costs. The fines were in respect of a Constellation flight from Gatwick to Georgetown, British Guiana, on March 25–30 in which insufficient dinghies were carried for the 68 passengers on board, and proper navigational equipment for Atlantic flights was not installed. Captain Kozubski, who flew the aircraft, pleaded guilty to summonses concerning offences contravening the Civil Aviation Act, 1949, and the Air Navigation Order, 1960. Mr Luther, a Ministry flight operation inspector, had seen the Constellation at Gatwick on March 8 and recommended the installation of a Loran long-range radio fixing aid and a roof-mounted periscopic sextant. Falcon could not install the latter, and the prosecution did not know who installed the Loran; the latter was in position when the Constellation left Gatwick on March 25, but it had not been possible to see whether it was working properly. It was proposed to fly back to Britain via Gander without being more than 90 minutes flying time from land; the aircraft would not then have been subject to the requirements for carrying dinghies.

The Constellation left Georgetown on March 28 with 68 West Indian immigrants and was diverted to Stephenville, Newfoundland, because of bad weather, going on to Gander the next day. The Loran was not working, and on arrival at Stephenville a baby of one of the passengers was found to be suffering from pneumonia. It was seen by a doctor both here and at Gander and, according to the defence, it was made clear to Captain Kozubski that any suggestion of leaving the sick child at Gander would raise insurmountable difficulties. He therefore decided to get the child to England as soon as possible and this meant taking a more direct course different from that laid down in the flight plan. If there had been an accident, any search and rescue operations would have been directed about 80 miles off course. There were enough dinghies on board for 44 passengers.

TALKING ABOUT FREEDOM

EVERY year the European Civil Aviation Conference, which is the European branch of ICAO, has a meeting at Strasbourg. The basic purpose of these meetings is to enable governments to find ways and means of easing the political barriers to the expansion

Recent guests of the East African Directorate of Civil Aviation in Nairobi were (second from left) Mr J. Murrow, senior ATCO at Salisbury, Southern Rhodesia, and (right) his colleague, Mr van Olst, chief telecommunications officer of the Federation. They were studying the East African ATC organization. With them are (left) Mr S. A. Worthy, Mr Olst's counterpart in the East African DCA's department and (second from left) Mr C. N. Dickson, East Africa's senior aviation officer



Photographs show Blackburn NA39 low-level strike aircraft, and close-up of wheel assembly. By courtesy of Blackburn Aircraft Limited.

Blackburn NA39's will come in on Goodyear

WINGS DAY SEPT. 16th GIVE FOR THOSE WHO GAVE

When they land, production Blackburn NA39 aircraft will be depending on tyres, wheels, brakes and anti-skid equipment by Goodyear—proved equipment that's without peer for efficiency, reliability and economy in weight.

Brakes—maximum non-fading reserve of braking power. Light and strong. Rapid cooling. Easy to maintain.

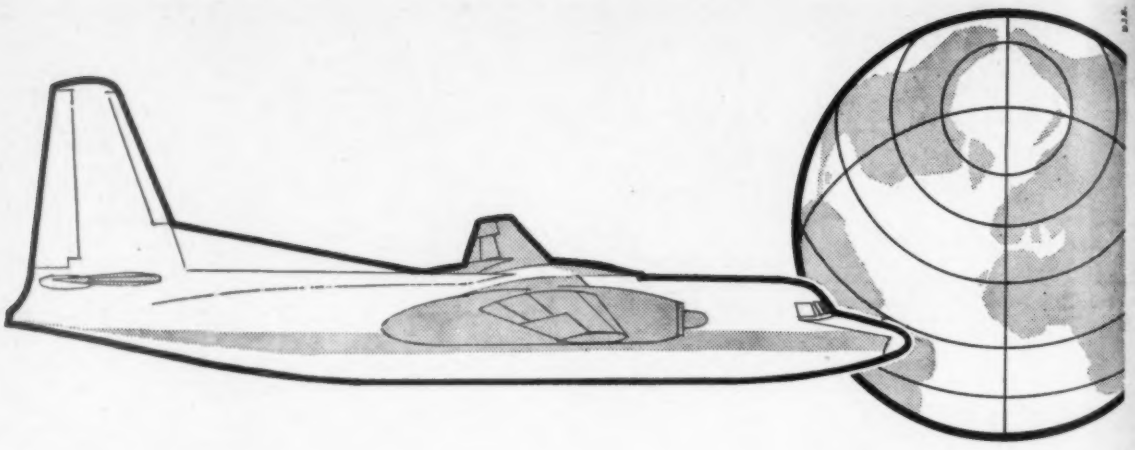
Anti-skid equipment—prevents wheel-locking and protects braking system.

Wheels—divided at centre to facilitate tyre-mounting and withstand strain of high landing speeds.

Tyres—Ribbed Tread design with tough, high-tensile cord carcass.

GOODYEAR AVIATION DIVISION

SERVING AVIATION THE WORLD OVER



FRIENDSHIP OF NATIONS

Fokker

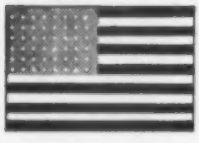
Through the centuries wise fellows like Socrates and Homer and Shaw discussed the art of being careful about friendships and money. Of course you agree.

If you buy anything, from a pin to an aircraft, you're smart to insist on something of proven value and proven quality. The people who build the Fokker F.27 Friendships have you in mind. Into the Friendship has been built economy, adaptability and money-earning capacity. The F.27 flies over deserts, pampas and water, in all climatic and geographical conditions, with complete dependability; comfort, and at the lowest possible seat mile cost.

It's unique. Today the Friendship is the only aircraft of its type in regular service in the world to have proved itself over 350,000 flying hours. Passengers like its pressurized cabin comfort and high wing visibility; airline operators in 19 countries appreciate its fatigue-safe structure, its performance and reliability.

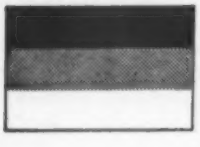
As T.H. Davies, president of the American Piedmont Airlines says: "the F.27 is the most efficient and economical short range transport aircraft available today". In five continents the Friendship of nations builds business.

IN ANY LANGUAGE



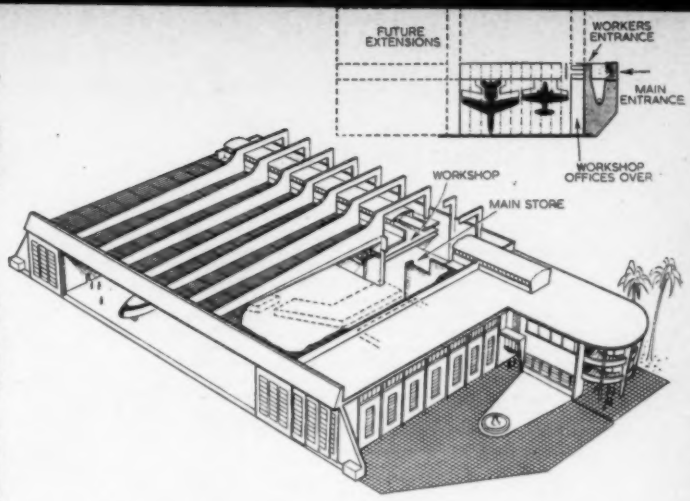
A man should make friends and money, in that order, and use both wisely. Friendships are jewels and there is more art in saving than gaining.

Insan, sirasi ile, dost ve para edinmeli ve ikisinide akillica kullanmalıdır. Dostluk bir ziynettir ve kazanmaktan çok onu devam ettirebilmek bir san'attir.



Der kluge Mann gewinnt erst Freunde und dann Geld. Freundschaften sind wie Perlen, und es ist schöner zu bewahren als zu gewinnen.

Een verstandig mens maakt eerst vrienden en dan geld, en gebruikt beide met overleg. Vriendschappen zijn als juwelen en het is een grotere kunst te sparen dan te verdienen.



Suitable for VC10s, of which Nigeria Airways will have two from BOAC's fleet of 15, the African airline's new engineering hangar at Lagos is depicted in this architect's drawing. Consultant engineers are Hedley S. Crabtree & Co Ltd of London and the architect is Mr R. A. Rathbone. The small diagram shows the planned future extensions

AIR COMMERCE...

of European air transport. The ideal, of course, is a multilateral agreement on free trade in the air; and while progress is inevitably slow, a little bit more liberality is agreed in principle each year. Usually the ECAC publishes a communique at the end of each annual meeting, summarizing what took place; this year it did not do so, but it is possible nevertheless to obtain a broad picture of what transpired.

The meeting took place from July 5 to July 19. One important agreement was that the multilateral on non-scheduled services (*Flight*, April 15, 1960, page 545)—which is a really quite successful attempt to liberalize non-scheduled operations in Europe—should now be extended to include closed groups. The UK definition of a closed group, as laid down in the Civil Aviation (Licensing) Regulations, 1960, appears to have been accepted. The most important, and surprising, decision was that there will not be another full meeting of the ECAC until 1964. This is not considered to be an indication that the ECAC is tired; the idea is that the machinery will be more manageable if small groups are allocated to examine specific problems.

It was agreed, for example, that the Institut de Transport Aérien should undertake a study of European non-scheduled operations, rather similar to the study the ITA did on the inclusive tour business. The report is due to be ready in March. And it was resolved, in principle, to try to find some way of embracing inclusive tours within a multilateral agreement. The expansion of air freight was discussed and a specialist group was asked to submit its views on ways and means of easing national formalities and to recommend ways in which governments could be more liberal in their attitudes towards air freight traffic.

THE MAGIC POOL

RECENT issues of Air-India's admirable staff magazine *Magic Carpet* have contained interesting references to the BOAC/Qantas/Air-India tripartite pool agreement. Reporting earlier in the summer on the completion of the first year of the pool (which ended in October 1960) Mr B. W. Patel, the general manager, said that the airline has raised "substantial amounts" from the pool, this being "mainly due to the fact that we had the largest equipment." (During half the year concerned, Air-India operated 707s as well as Super Constellations; BOAC operated Comets and Britannias, and Qantas Boeing 707s.) Mr Patel noted that "in the initial stages of a pool there is always disparity and imbalance." He does not say which airline benefited from this imbalance during the first year of the pool, but it is reasonable to infer that it was Air-India; during 1960-61 Air-India's overall load factor plunged drastically—to 47.3 per cent compared with 58.2 per cent in the previous year. Passenger load factor fell to 50.1 per cent from 56.8 per cent. Mr Patel says that, but for the pool, Air-India would not have introduced Boeings and opened the North Atlantic route in the same year.

Writing in another recent issue of *Magic Carpet*, Air-India's financial controller, Mr N. J. Pavri, refers to "substantial credits received from the tripartite revenue pool." This pool, he says, eliminates competition among the pool partners and, so far as the total pool receipts are concerned, "it does not matter very much as to which partner actually carries the traffic." He adds, however, that it should be the company's "constant endeavour" to increase the revenues earned by all three partners.

Noting that the Indian Government has absolved Air-India from all interest payments until October 1, 1966, largely because of the airline's interest commitments on its Boeing 707s, Mr Pavri says that this is "a dispensation for which the corporation is very grateful to the Government." No doubt Air-India is gratified also by the recent decision of the US Ex-Im Bank to advance a loan of $8.1m to the Indian Government to meet part of the dollar expenditure on the purchase of two additional Boeing 707-420s by Air-India.

It appears that, thanks to a beneficent government, a helpful Ex-Im Bank, and what is evidently a highly favourable pool agreement with BOAC and Qantas, Air-India is having a very smooth financial passage into the jet age.

Footnote: The BOAC/Qantas/Air-India pool agreement is likely to be discussed at the ATLB hearings, due to come up in the second half of November, into British United's application for Far Eastern routes. It will be recalled that this agreement contains a clause giving BOAC exclusive rights to scheduled services on the routes concerned in the pool.

HOW TO SATISFY THE ARB

THE ARB's notice to licensed aircraft engineers and to owners of civil aircraft No. 60, Issue 2, issued on August 1, deals with the requirements for an Air Operator's Certificate, and supplements the Ministry's original *Notes for the Guidance and Information of Applicants for an Air Operator's Certificate*, discussed in our issue of January 20. An AOC is of course a legal requirement for all operators of public transport aircraft of over 5,000lb a.u.w. The Ministry seeks the advice of the ARB in matters of engineering competence; and here, published for the first time, is what the ARB expects an AOC-worthy operator to show.

A current maintenance schedule, approved in accordance with British Civil Airworthiness Requirements, must be available for each aircraft operated. In addition to the more obvious requirements such as sufficient skilled engineering staff, sufficient hangar space, equipment and workshop facilities, suitable quarantine and bonded stores must be provided together with suitable stores records.

Current technical literature and drawings must be available for the aircraft concerned, and there must be an arrangement with the manufacturer whereby the operator is notified of all amendments to and reissues of such literature and drawings.

Where any part of the maintenance is to be carried out at a route station, the operator must ensure that acceptable facilities are provided and appropriately licensed aircraft engineers are available for certification purposes. Such additional maintenance facilities as may, in the ARB's opinion, be necessary for the particular type of operation must be provided, and the ARB will make periodic checks to ensure that maintenance facilities are up to standard. Where an operator does not intend to carry out his own maintenance, alternative arrangements made with other maintenance organizations, and the operator's liaison with the latter, must be approved by the ARB.

Aerolineas Argentinas is to be the first Avro 748 customer to take delivery. Visiting Avro's Woodford and Chadderton factories on August 31 were officials of the airline, which has ordered nine 748s. From left to right, Mr C. L. Hatton, general superintendent, Woodford; Ing Cagnacci, engineering director, Aerolineas Argentinas; Mr P. R. Hildebrandt, London manager, Aerolineas Argentinas; Mr E. Golitzine, sales manager, A. V. Roe & Co. Ltd; Brig E. Mirant Borde, vice-president of Aerolineas Argentinas; and Ing Aeron R. E. Tizio, Aerolineas Argentinas technical representative resident at A. V. Roe

AIR COMMERCE...

Air Freight and British Trade

A SAMPLE STUDY OF CURRENT CONDITIONS Part 1

By KENNETH R. SEALY and PETER C. L. HERDSON

AS recorded in "Flight" for August 24, Hawker Siddeley Aviation recently published a study, by Dr K. Sealy and P. C. L. Herdson of the London School of Economics, of the European freight market.[1] The work has been summarized specially for "Flight" by the authors, and this is the first instalment. Primary aim of the study was to investigate the part played by air freight in the physical distribution of goods. The survey was intensive rather than extensive, and covered the export of machinery and textiles from the United Kingdom to Europe. In this first part the authors make a general appraisal of United Kingdom air freight, with special reference to Europe. A similar appraisal provided the basis for the field survey and enabled them to pinpoint the commodities which are currently important in air freight; and the survey was accordingly devoted to the study of machinery and textiles.

AIR FREIGHT in developed countries differs considerably from air passenger traffic in that a high proportion of total passenger traffic now travels by air whereas only a tiny proportion—less than one per cent—of the total goods traffic goes by air. Thus in Europe air traffic accounts for about 45 per cent of the passenger traffic volume between the UK and the Continent, while in the USA air passenger traffic is greater than any other form of inter-city common-carrier traffic. Growth in air freight will largely result from the diversion of existing traffic on surface routes, whereas passenger-traffic growth will depend far more on creating new traffic. The total goods traffic is itself rising, and Brewer[1] has shown that this growth is closely linked with the rise in a country's gross national product. Hence air freight's future depends on the increase in total goods traffic and the degree to which such traffic can be diverted to air transport, together with any new traffic which the medium may itself create.

The chief stumbling-block in all this is to assess just what air freight's share of the total is likely to be. The factors here may

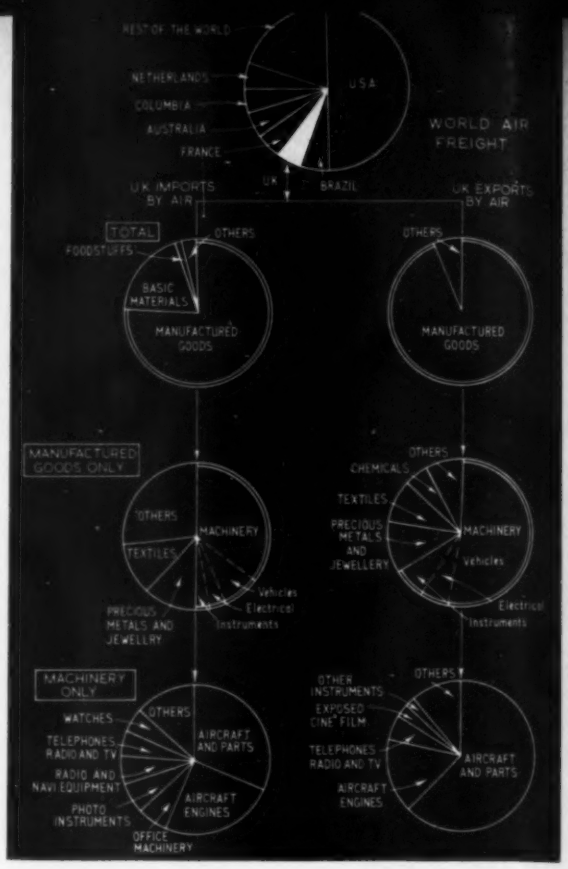


Fig 1 (above) A summary of UK air freight, 1957, showing the UK portion of the total world air freight market broken down into imports and exports and sub-divided to show the type of commodity

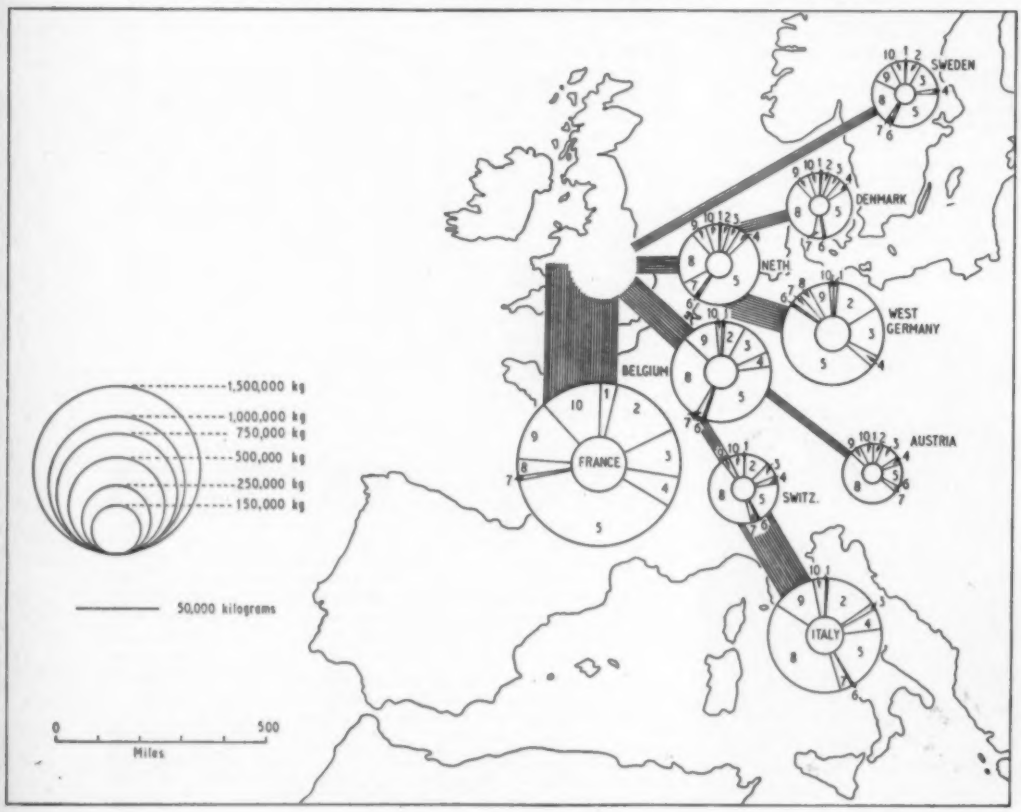


Fig 2 (left) Distribution of BEA total air freight exports in 1957: (1) Food; (2) inedible animal and vegetable products; (3) textiles, etc; (4) metals; (5) machinery, vehicles and electrical equipment; (6) non-metallic materials and products; (7) chemicals; (8) paper, reed, rubber and wood products; (9) Scientific and precision apparatus; (10) Miscellaneous

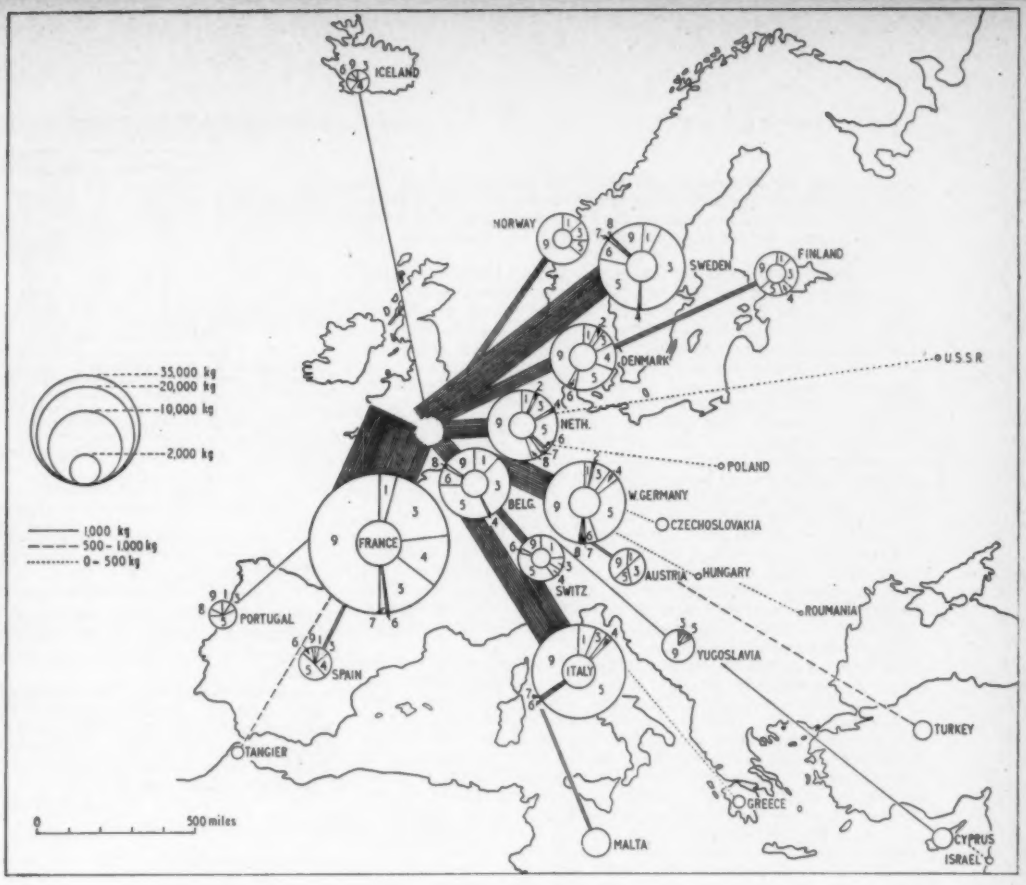


Fig 3. Distribution of BEA machinery traffic (April 1959) (1) Miscellaneous metal products; (2) business and office machinery; (3) vehicles and spares; (4) aircraft and spares; (5) electrical machinery (radio, etc); (6) engines and turbines; (7) electrical machinery (motors, welders, etc); (8) electrical machinery (domestic); (9) other machinery

be summarized as follows: (a) relationship between air and surface rates; (b) quality of service—speed, handling, etc; (c) acceptance of air freight as a normal means of transport.

All of these are in fact part of one process—the distribution of goods from the factory or warehouse to the customer. Discussions that involve only transport costs ignore other cost items—e.g., packing—as well as such elements as the total time involved in the process. Up to the present air freight has largely resulted from emergency shipments, from shipments where speed would extend the market, or from cases in which transport costs were lower by air. Just how far goods are shipped by air because total distribution costs are lower is practically unknown,[2] yet it is potentially the most viable of all reasons. It was in order to throw some light on total distribution costs and the air freight market that we undertook our original survey.

Such an undertaking is only possible in a limited time by restricting the field covered. In order to do this an overall study of UK air freight was made to provide a basis upon which more specialized work could proceed.

UK Airborne Trade Fig 1 summarizes the position, demonstrating in the upper graph not only how restricted air freight is in volume, but also in area. The USA alone accounts for 49.5 per cent of total world air freight, the next ten countries account for 38 per cent, while the remaining 12.5 per cent is shared amongst the rest of the world. The UK is responsible for 6 per cent of the total. The remaining graphs in Fig 1, breaking down UK airborne trade by value, reveal the overwhelming dominance of manufactured goods in total trade. Characteristic of the air market is the similarity in flow for both imports and exports, for air freight does not embrace the weighty movement of basic materials into the country. Taking the most important commodity groups, we get the results given in Table 1.

The final pair of graphs in Fig 1 break down the machinery category, which, if vehicles and instruments are included, is by far the most important commodity group. The trade in precious metals, bullion and jewellery consists to a large extent in movements of platinum. Jewellery accounts for £1m of the imports and £0·4m of the exports. If adjustments are made to consolidate the machinery category to include vehicles and instruments, and precious metals are omitted, the three major categories for both imports and exports become (a) machinery, (b) textiles and clothing, (c) chemicals and drugs.

The graphs in Fig 1 deal with total airborne trade, a field far too large for detailed study, and subsequent effort was directed towards Europe only, and particularly to the export trade in machinery.

Anglo-European Air Freight UK trade with Europe ranks second to the Sterling Area in importance, and is primarily directed to the countries of western Europe (see Table 2). Of this trade, a higher percentage is between the UK and the countries of the Common Market than with those of the Free Trade Community, i.e., 10 per cent more in imports and 14 per cent in exports.

Detailed tables of Anglo-European air freight are tedious to plough through, and our results are presented here mainly in the form of maps and diagrams. Figs 2 and 3 show the distribution of BEA's freight traffic, both for total exports and for machinery alone. Unlike the trade figures already given, these are based on weight and not on value.

The bulk of the traffic occurs between the UK and the adjacent countries of the Continent, with Sweden and Italy outlying the ring. Stage-lengths on most routes are below 500 miles, Sweden and

TABLE 1: UK AIRBORNE TRADE, MANUFACTURED GOODS, 1957

Imports (£m)			Exports (£m)		
Machinery:			Vehicles		58.3
mechanical	12.9	19.8	Machinery:		
electrical	6.9		mechanical	22.5	32.7
Textiles and clothing:			electrical	10.2	
textiles	6.9	13.4	Precious metals, bullion, jewellery		16.6
clothing	6.5		Textiles and clothing:		
Vehicles		10.2	textiles	5.4	12.6
Precious metals, bullion, jewellery		8.4	clothing	7.2	
Instruments		7.3	Instruments		8.0
Chemicals and drugs		4.4	Chemicals and drugs		6.5
Metal manufactures, less machinery and non-ferrous metals		1.3	Leathers and furs		3.4
Total, all manufactured goods		74.2	**Total**, all manufactured goods		147.9
Grand total, all imports		94.7	**Grand total, all exports** (UK produce)		158.3

TABLE 2: RELATIVE IMPORTANCE OF EUROPEAN COUNTRIES IN UK TRADE, 1957

Rank	Total Trade				BEA		BEA and national		Train ferry	Machinery		
	Total		Mfd. gds.							Tot.	BEA	TF
	I	E	I	E	I	E	I	E	E	E	E	E
1	Sw	G	G	N	F	F	N	F	F	F	F	F
2	N	N	F	G	N	I	F	N	B	N	G	G
3	G	Sw	I	F	G	G	Sz	B	G	B	I	Sz
4	D	F	Sz	Sw	I	B	B	I	Sz	Sw	I	B
5	F	D	N	B	B	N	Sw	G	I	I	N	I
6	Fd	B	B	I	Sz	Sz	G	Sz	N	G	Sw	N

Notes: BEA and national: BEA traffic together with that of the other major operator to country concerned. Machinery: total BEA and train ferry traffic in machinery. *Abbreviation* : I, imports; E, exports. (*Countries*) G, W. Germany; N, Netherlands; F, France; B, Belgium; I, Italy; Sw, Sweden; D, Denmark; Sz, Switzerland; Fd, Finland.

AIR COMMERCE...

Italy forming the only major markets where distances exceed this limit. Whereas France ranks only fourth in the total export trade to Europe, and third for trade in manufactured goods, she is the leading country for air freight and—as Table 2 shows—for rail ferry also.

A comparison between air freight and surface traffic is fraught with difficulties, not the least of which is the bewildering array of rates used by all forms of transport. At a later stage we shall be dealing with this problem from the standpoint of particular consignment types, where field evidence has been gathered, and where it is possible to keep the analysis in hand. However, some general assessment seems warranted. Since rail ferry rates are generally higher than sea transport, it might be supposed that air freight would be more likely to compete with rail than sea transport. In fact, the air freight contribution is relatively very small. To judge how far the traffic itself is similar, we need to consider the commodities shipped and the market areas, as summarized in Tables 2 and 3.

For the major markets BEA's traffic expressed as a percentage of the rail ferry traffic is as follows: France, 5; Italy, 5; West Germany, 3; Belgium, 3; Netherlands, 20; Switzerland, 2.

Most striking is the fact that machinery is easily the dominant category for both rail and air transport, and that France is the leading market. Here surely is an indication of a competitive situation, but one cannot be sure until detailed work dealing with individual commodity movements is taken into account. Waybill analysis does reveal competition.

Scientific instruments, electronic and TV equipment and watches are important both for air and rail ferrying, while the heavier electrical equipment generally moves by sea. Refrigeration plant mainly moves by rail ferry. The position is, of course, not static, and air freight offers increasing competition in some fields. The Netherlands rank lowest in the train ferry column in Table 2 because her major cities are within easy access to tidewater and she does not lie on the main train ferry routes. In comparison with the rail ferries, therefore, BEA's traffic is relatively high in this market.

For the remaining commodity groups we should note that newspaper traffic is responsible for most of the BEA traffic under "paper, reed and rubber products" and more specialized items (e.g., cut flowers) for the third category of "inedible animal and vegetable products." Indeed, if manufactured goods are considered, the BEA order becomes very similar to that for the total airborne trade given in an earlier paragraph—machinery, textiles and clothing, metal manufactures, chemicals and drugs. Rail ferry traffic shows a much higher proportion of trade in chemicals, foodstuffs and non-metallic materials and manufactures (e.g., glassware) and ceramics.

TABLE 3: COMPARISON OF BEA AND RAIL FERRY EXPORT TRAFFIC TO THE MAJOR EUROPEAN COUNTRIES, 1957 (nearest long ton)

Commodity group	Rail ferries	BEA
1	14,270	58
2	12,200	474
3	—	315
4	3,120	190
5	35,851	1,667
6	13,730	21
7	26,670	133
8	2,681	780
9	54,789	124
Grand Total	163,311	3,762

BEA and other main operator on each route: 7,517.

Commodity List: 1, Foodstuffs; 2, inedible animal and vegetable products; 3, textiles and clothing; 4, metals and metal manufactures; 5, machinery, vehicles and instruments; 6, non-metallic materials and manufactures; 7, chemicals and drugs; 8, paper, reed and rubber products; 9, other goods. For train ferries one-third of the "other" category is classed as groupage, of which 40 per cent is machinery, and 20 per cent of the remaining two-thirds is also machinery. Figure given under "other" is the residual after extracting machinery. Machinery added to machinery total.

TABLE 4: UK EXPORTS, 1957 (tons × 1,000)

	France			West Germany		
	Sea	Rail	Air	Sea	Rail	Air
Heavy electrical equipment	0.4	0.2	—	0.2	—	—
Refrigerators	—	0.2	—	—	0.7	—
Electrical and radio	0.6	0.3	0.1	0.5	0.1	0.2

Analysis of waybills gives the following picture of consignment size, weight, etc. Some 80 per cent of the consignments are 45kg or less in weight, account for 20 per cent of the total weight, and give 30 per cent of the revenue. On the other hand, consignments of 500kg or more account for 2 per cent of the total number, 37 per cent of the weight, and 27 per cent of the revenue.

(To be continued)

References

(1) Brewer, S. H.: *Air Cargo—the Next Ten Years* (1957), and *US International Air Cargo* (1958); The Boeing Company.

(2) Lewis, H. T., and Culliton, J. W.: *The Role of Air Freight in Physical Distribution*; Harvard, 1956.

(3) Sealy, K. R. and Herdson, P. C. L.: *Air Freight and Anglo-European Trade—a Sample Survey*; Aerospace Technical Services, 1961.

ELEVEN IMPORTANT GAPS

THE Cornell-Guggenheim Aviation Safety Center's eleventh annual survey* demonstrates just how vast the subject of aviation safety has become, listing as it does nearly 1,700 abstracts of projects being conducted by various bodies concerned with safety. The survey lists eleven "most important gaps" which demand attention in current aviation safety research and practice, and points out that US airlines suffered the largest number of passenger fatalities in 1960 (336) since the Civil Aeronautics Act came into force in 1938. Approximately 40 per cent of this total, it is pointed out, were caused by the DC-8/Super Constellation collision over New York. Air traffic control, not surprisingly, is listed as the number one "gap."

Passenger protection and weather forecasting are other gaps, and the survey comments that while the travelling public accepts the risks of inflammable fuel, high speeds and all-weather operations "it would seem that the airlines have the moral responsibility to provide their customers with the maximum protection that can be supplied within the state of the art."

Airport limitations are another gap: an ALPA survey last year revealed that of approximately 600 airports in the USA used by airlines, no less than 92 per cent of those surveyed had inadequate fire protection, 70 per cent had no approach lights and 58 per cent had no control towers.

A study covering 12 years of accidents and incidents during approach and landing reveals that 40 per cent of fatal accidents occur short of the runway threshold, between it and the outer marker. "Immediate installation of airborne equipment to utilize the DME facilities in 343 VOR stations is a must," concludes the survey.

Collision avoidance and crash fire protection are two more of the gaps listed in the survey. Of the former the survey says: "The December 1960 collision between two airliners [DC-8 and Constellation over New York] served to emphasize the importance of this problem, since if either aircraft had been equipped with a collision warning device the accident might not have occurred.

* *Survey of Research Projects In The Field Of Aviation Safety*, The Daniel and Florence Guggenheim Aviation Safety Center, Cornell University, 468 Park Avenue South, New York 16, price $2.50.

TRENDS IN MEXICO

UNTIL recently Guest Aerovias Mexico SA was suffering from lack of jet equipment, and although traffic had shown a considerable increase since SAS began to provide technical and operational assistance in 1959, finances did not show a corresponding improvement. A lengthy pilot dispute, as well as considerable training and development costs associated with the introduction of DC-6s and later L.1049G Super Constellations (the latter ex-Thai Airways aircraft acquired for Guest by SAS), resulted in a deteriorating financial position.

Guest's situation took a turn for the better with the introduction of Comets leased from Mexicana, and the injection of new capital by a strong group of Mexican financiers. The latter include Carlos Trouyet, Hernandez Delgado and Eduardo Villasenor, all of whom are now board members, as is Conrad Hilton; Folke Egerstroem continues as president. According to reports from Mexico this syndicate is to take over the £3,570,000 SAS share in Guest; shares owned by the airline's founder and president, Winston Guest, and worth about £1,780,000, will also be taken over.

SAS, which has enough financial problems of its own, has not participated in the refinancing of Guest, and their report for the year ending September 30, 1960, forecast a considerable loss on account of the financial support extended to Guest in the form of credit on sold aircraft and on technical and other services, cash loans and guarantees. SAS capital contributions will be repaid by Guest out of profits, and the Scandinavian carrier will continue as Guest's general sales agent. It remains to be seen whether Mr Curt Nicolin, who took over from Mr Acke Rusck on July 15 last, will retain the SAS minority shareholding in Thai Airways International, a SAS associate.

Introduction of Comets last spring greatly improved load factors on Guest's three services a week from Mexico City to Madrid and Paris—although a Comet 4C intended for operation by this carrier, duly completed by de Havilland, remains in storage at Hatfield. Traffic is also growing on the Mexico City - Guatemala City - San Jose - Panama - Curacao - Caracas routes served by ex-SAS DC-6s.

Guest's new financial strength should enable orders to be placed for its own jets in the near future, and the VC10, by virtue of delivery date and temperature/altitude performance, could be of more than passing interest to the Mexican carrier.

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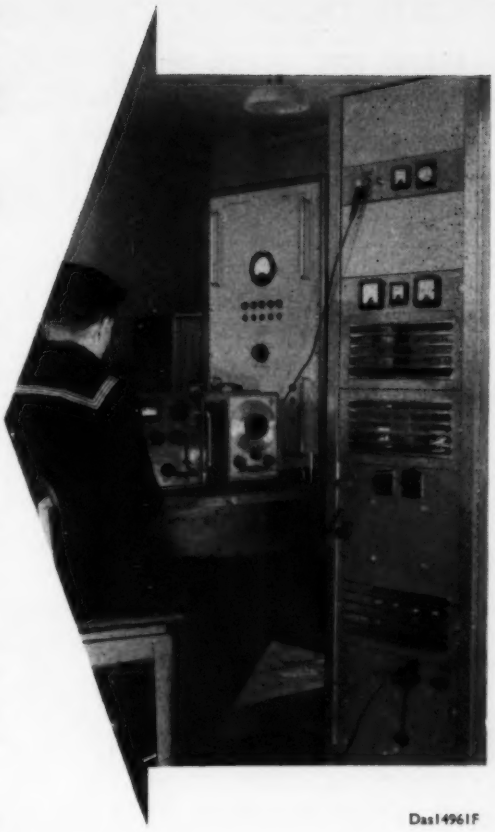

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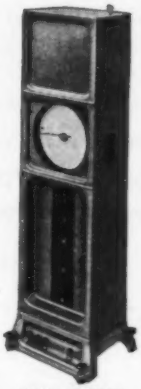

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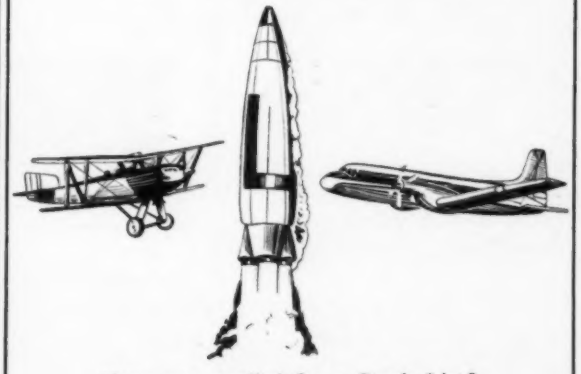

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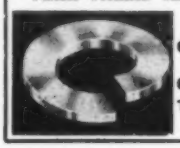

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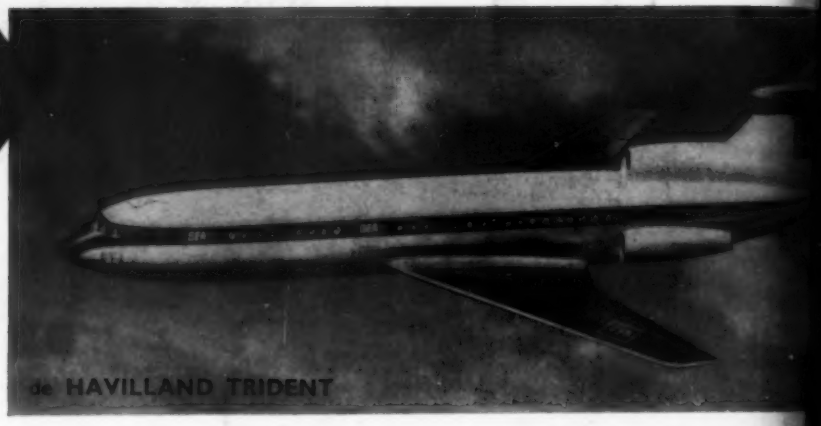
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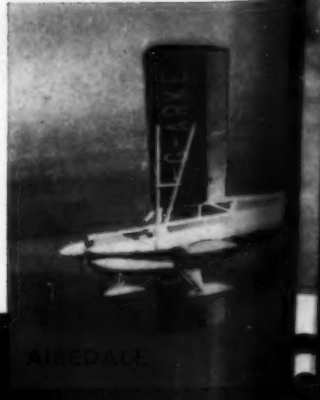
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